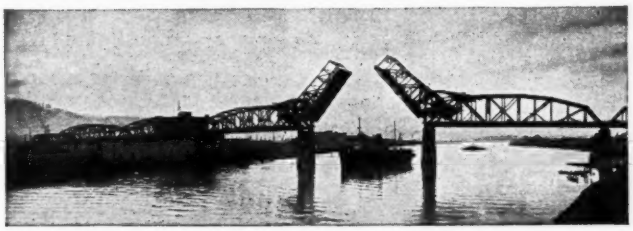
MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.



LARGEST *Bascule Bridge in the World—4,800 feet long. Over Willamette River, Portland, Ore.*

VOL. XLV. NOVEMBER, 1913. No. 5.

City governments are becoming more efficient each year. Progressive cities are calling on experts, who have spent years studying the efficient ways for cities and towns to administer their affairs, to come to them and investigate their problems and give them advice. Men are being employed by cities to act as general managers, commissions are studying the methods of large private corporations, and as a result are adopting ideas evolved by men and organizations who have been paid hundreds of thousands of dollars for what they know. MUNICIPAL ENGINEERING *will keep you alive to the important development in this great field.*

Published by

Engineering Publishing Co.
INDIANAPOLIS, IND.

New York Office:
1125 World Bldg.

Chicago Office:
1945 Com'l Nat'l Bank Bldg.
CHAS. A. DICKENS,
Western Manager.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

Russell Fortune, Prest. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscription Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

CONCRETE ROADS

A Careful Inspection of Various Concrete Roads Brings to Light Both Favorable and Unfavorable Data.

An Article Based Upon Two Separate Reports.

TWO reports upon the Wayne county, Michigan, and other concrete roads have been prepared recently, based on data obtained thru careful inspections of the roads.

One of these reports is in the form of a paper by Frank F. Rogers, state highway commissioner of Michigan, before the American Road Congress, and shows the results of a careful and minute inspection of each road early in September, 1913, the first of a series of such inspections which will be made at intervals to determine the action of this road material. The second is a report by P. E. Green, M. Am. Soc. C. E., made for the village of Highland Park, Ill., upon the question of the availability of this form of road construction for the streets of that municipality. His inspection was less minute but the general result is practically the same, therefore Mr. Rogers' report is used herewith as representing the results of both inspections, occasional remarks based on Mr. Green's report being interpolated.

The accompanying photographs accompany Mr. Green's report and show in general the characteristics described in Mr. Rogers' report.

The first mile of Woodward avenue was built in May and June, and opened to traffic in July of 1909, thus giving it full four years of wear. The traffic record of this road shows a daily average of 2,160 vehicles, of which 88.1 per cent. were motor driven.

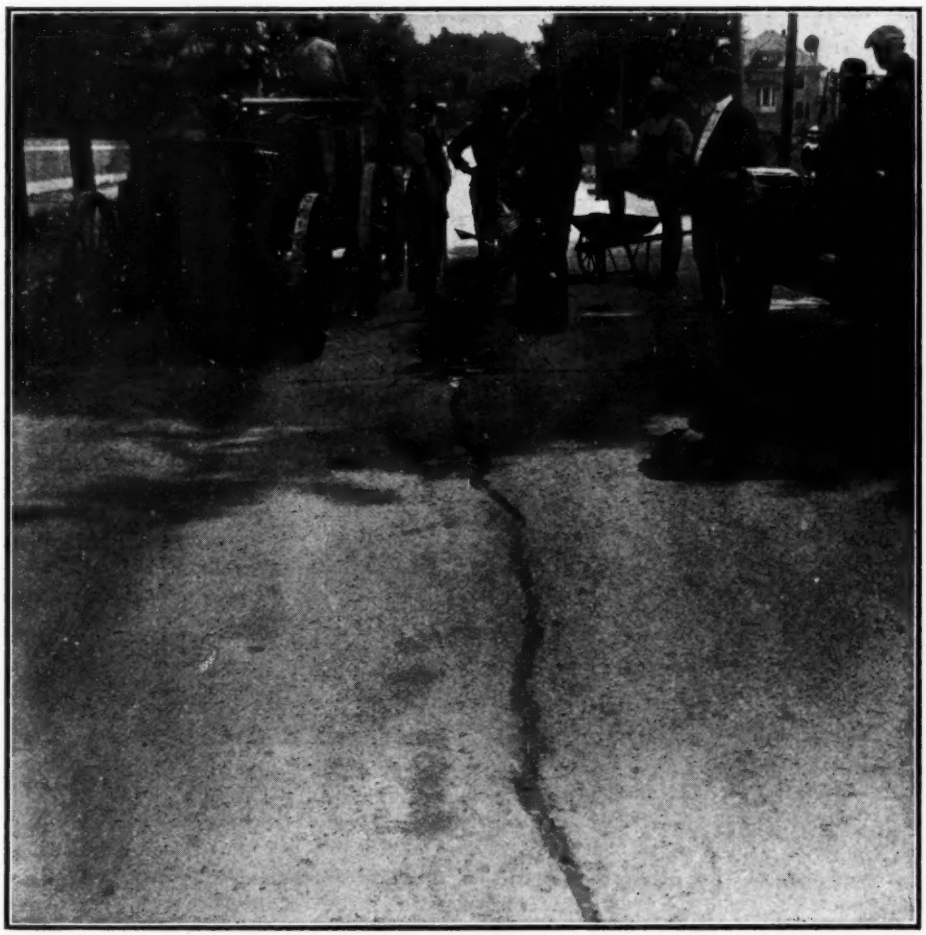
The soil is clay loam, inclining a little more to sand at the northerly end. A double track electric railway occupies the westerly side of the street. Between the railway and the concrete roadway is a very shallow gutter under which was laid a tile drain from 2 to 3 feet in depth. On the opposite side is an open ditch, the bottom of which is from 2 to 4 feet below the crown of the roadway.

The pavement is 18 feet wide, has a crown of 3 inches and a blind curb 8 inches wide and 4 inches deep under the outer edges which were somewhat beveled. The concrete was composed of portland cement, crushed field stone or cobbles and sand mixed in the proportion of 1:2½:5 for the base which was 4 inches thick. The top layer was made of the same materials, using a 1:2:3 mix and was 2½ inches thick.

No very definite data can be secured to determine the wear, which seems to be slightly greater on the side opposite the railway, but measuring from some of the harder pieces of the coarse aggregate which have been worn but little, if any, we have estimated the general wear at about ¼ inch, which would be an average of 1/16 inch per year.

This mile was divided into sections of about 25 feet, separated by expansion joints, there being 209 sections to the mile. The most of the sections were separated by four thicknesses of tar paper separated by thin boards which it was planned to remove as the work progressed, tho many of the boards are still in the pavement. Four of the joints were protected by pairs of steel angle bars, separated with tar paper and placed with one leg of each angle back to back so that the other leg of each bar was

flush with the surface of the concrete, thus covering a space of about 4½ inches at the joints. The concrete wears slowly on each side of the angles, leaving a raised joint that is slightly noticeable when driving over the pavement. This was an experiment which has not been repeated.



REPAIR *gang repairing River Road with tar in* 1913. *This gang of seven men, with outfit, costs* $21.75 *per day, not including fuel for heating tar.*

Of the 209 sections constituting the first mile on Woodward avenue, 80 showed longitudinal cracks, 32 transverse cracks and 2 diagonal cracks while 46 sections were recorded as having holes, making a total of 160 sections which are more or less imperfect, or 76.5 per cent. of the entire mile.

The remaining portion of Woodward avenue, 252 sections, was built in 1910 using the same materials and the same mix. No blind curb was used and the crown was reduced to 2 inches. The soil on this section is considerably more sandy, especially toward the north end.

On this portion of Woodward avenue, 29 sections have longitudinal, 22 sections transverse, and 6 sections diagonal cracks and 11 sections have holes, making a total of 68 defective sections or 27 per cent. as compared with 76 per cent. in the first mile.

Mr. Green considers this a good road in good condition.

On Gratiot avenue in the season of 1910, 9,000 feet of 16-ft. concrete roadway was built. On this pavement gravel and sand were used for the aggregate and a one layer concrete having a 1:2:4 mix was laid. The soil is a clay loam and rather heavy. This road was not completed until late in the season and was opened to travel in November. It immediately pitted and looked rough and has been covered with a surface treatment of refined tar and fine gravel. It was re-covered this season, using a rather light grade of tar (Tarvia A) but it already shows some tendency to scale off. The experience in some other places leads the Commission to believe that a heavier grade of tar gives better results.

On the Grand River road 61 sections of two course concrete, the same as laid in the first mile of Woodward avenue, were built in 1909. The soil is a clay loam. The records show 11 longitudinal cracks, 2 transverse cracks, 1 diagonal crack and 3 holes, a total of 17 defective slabs or 27.9 per cent. The traffic count showed 1064 vehicles, 56.5 per cent. of which were motor cars.

In 1910 341 more sections were added to Grand River avenue under contract, the specifications being the same as for the north end of Woodward avenue. Thirty-three of these slabs became more or less pitted, some having quite large holes. They have been repaired by covering with refined tar and stone chips so

FAULTY *concrete well repaired. 1911 section Grand River Road. Many hundreds of small holes must be repaired each year with tar and sand.*

Beyond this portion of the roadway 326 sections of the same width concrete were laid in 1911 reaching to the county line. Washed pebbles and sand were used for the aggregate in a 1:1½:3 mix, one course concrete 7 inches deep being laid. The records for this piece are as follows: Longitudinal cracks, 11; transverse cracks, 10; diagonal cracks, 3; holes, 6; showing a total of only 30 defective slabs or 9.2 per cent. The traffic count on this road, taken at the county line, shows 507 vehicles daily, 65.8 per cent. of which are motor driven.

Mr. Green considers this road a failure protected from complete disintegration by the tar treatments.

that no defects could be observed at the time of the count, hence only 308 are shown in the table. The defects noted are as follows: 59 longitudinal, 20 transverse, 29 diagonal cracks and 46 holes, a total of 154 defective slabs or 50 per cent.

In 1911, 515 additional sections of one course concrete were placed on the Grand River road. Washed pebbles and sand were used for the aggregate with a 1:1½:3 mix. The Baker steel joint was used in all of this work except the first six sections. The defects noted are as follows: Longitudinal cracks, 8; transverse, 26; diagonal, 3; and holes 5, making a total of 42 defective sections or 8.2 per cent.

In 1912, 1,208 more sections were added

to Grand River avenue reaching to the line between Wayne and Oakland counties. The count on these sections shows as follows: 66 longitudinal cracks, 37 transverse cracks, 6 diagonal cracks and 5 holes, making a total of 114 defective sections or 9.4 per cent. The soil grew more sandy as the road extended westerly, considerable stretches being almost free from clay or loam.

Mr. Green considers this road to be not so good as Woodward avenue tho it has fewer cracks. Some of his remarks are given in explanation of the photographs.

¶ MICHIGAN AVENUE *will require careful maintenance to prevent disintegration.*

On Michigan avenue 481 sections of concrete, 17-ft. 8-in. wide were laid, using washed pebbles and sand for the aggregate in a 1:2:4 mix. The soil for the most part is a sandy loam, but a little heavy. The count shows as follows: 219 longitudinal cracks, 48 transverse cracks, 23 diagonal cracks, 21 holes, making a total of 311 defective sections or 64.6 per cent. The traffic count shows 1009 vehicles, 67.5 per cent. of which were motor driven.

Mr. Green thinks this section would go to pieces in two or three years more if not carefully maintained.

In 1911, 1570 sections were added to this piece of road, using washed pebbles and sand for aggregate and a 1:1½:3 mix. The soil over which this pavement was laid is a sandy loam running into light sand at the west end. The count shows the following: 219 longitudinal cracks, 80 transverse cracks, 42 diagonal cracks, 14 holes, making a total of 355 defective sections, or 22.6 per cent. In 1912 this road was paved to within 1¼ miles of the county line, and this year completed to the county line, but no record was taken farther west than the east limits of the village of Wayne.

All observers unite in considering this section a fine example of a good concrete road.

In 1910, 149 sections of concrete 15-ft. wide and 6½ inches deep were laid on the River road, using gravel and sand for the aggregate and a 1:2:4 mix. The soil over which this road runs is for the most part heavy clay. The count shows as follows: 49 longitudinal cracks, 5 transverse cracks, 6 diagonal cracks and 2 holes, making a total of 62 defective sections or 41.6 per cent. The traffic count shows 538 vehicles daily, of which 78.9 per cent. were motor driven.

In 1911, 434 sections were added to this road some distance below the village of Trenton. The pavement was 15 ft. wide,

SURFACE *of Fort Road, 1910 section. Tar badly scaled.*

7 inches thick, built of washed pebbles and sand for the aggregate, using a 1:1½:3 mix. The count for this stretch of road shows as follows: 165 longitudinal cracks, 17 transverse cracks, 13 diagonal cracks and no holes, a total of 195 defective sections or 44.9 per cent.

In 1912, the gap between this piece of road and the southerly limits of the village of Trenton was closed in with a similar pavement to that just described, comprising 213 sections. The count on this piece shows defects as follows: 14

longitudinal cracks, 8 transverse cracks, 4 diagonal cracks and no holes, making a total of 26 sections or 12.2 per cent.

The same year there was added to the south end of the work done in 1911 something over two miles of concrete roadway, but of this only 208 sections were counted. Of the sections counted, 17 show longitudinal cracks, 9 transverse cracks, no diagonal cracks and no holes, a total of 21 defective sections or approximately 10 per cent. The soil of the entire road was heavy clay.

Mr. Green reports considerable wear and many small holes in the earlier sections of this pavement, in addition to the cracks. The latest section he considers excellent. One of the photographs shows a crack under repair for the second time.

In 1910, one-half mile of gravel concrete of a 1:2:4 mix, 12 ft. wide and 6½ inches deep was built on Fort street. This concrete like that already referred to on Gratiot avenue was built rather late in the season and was opened to traffic in November. It immediately pitted to such an extent that it has since been coated with refined tar and fine washed gravel, about ¼ inch in size. This covering makes an excellent surface and wears fairly well. Of course it was impossible to observe any further defects in the concrete at this time. Continuing south, in 1912 450 sections of concrete 12 ft. wide and 7 inches deep, and of 1:1½:3 mix were added. The count on this piece of road follows: Longitudinal cracks, none, altho another observer has reported there are 2; transverse cracks, 19; diagonal cracks, 9, and holes, 1. Total defective sections, 29, or 6.5 per cent.

Mr. Green seems to consider the 1910 section as one of the worst sections he saw, and the 1912 section the best. The concrete in the 1910 section he reports to look more like plain macadam in some places, and one of the photographs shows the scaling from the surface of the tar with which it has been surfaced in making repairs.

Mr. Green reports on two roads not included in Mr. Rogers' paper. The Mack road is 15 feet wide. The section built in 1910, 1,600 feet long, is one 6-inch course of 1:2:4 sand and gravel concrete, and cost $1.347 a square yard. It is in very bad condition, was surfaced with bitumen in 1912, but that is practically all gone, as one of the photographs shows. It has fairly heavy traffic with much teaming. The section built in 1911, 1,400 feet long, is one 7-inch course of 1:1½:3 washed sand and gravel concrete, and cost $1.75 a square yard. This section is beginning to wear in ruts from heavy hauling to Lozier automobile plant.

¶ MT. ELLIOT *Road in good condition, parts of it being an excellent example of concrete roadway.*

Mt. Elliot road, 12 feet wide and 4,000 feet long, built in 1910, is in 2 courses, one of 4 inches of 1:2½:5 sand and limestone and one of 2 inches of 1:3, and cost $1.44 a square yard. The surface is good, but 19 cracks in the length, nearly all longitudinal. Considerable patching has been done with tar and sand at joints and on sides. Lack of longitudinal cracks is attributed to narrow width. Traffic is fairly heavy hauling to railroad yards. The section, 18 feet wide and 2,400 feet long, built in 1911, is one course of 1:1½:3 screened sand and pebble concrete and cost $1.65 a square yard. The surface is good and only 13 slabs had cracks, all transverse, which have been repaired. There is considerable heavy hauling and the road is in good condition. The section, about 1,000 feet long, built in 1912, is in good condition and a fine piece of road.

Mr. Green's report includes also observations upon streets in Highland Park village adjacent to Detroit, and Windsor, Ont., which are far less satisfactory.

A comparison of the conclusions drawn by the two engineers will be interesting in view of the general agreement upon the facts in the case, Mr. Rogers' report of facts being more severe upon the roads, if anything, than is Mr. Green's.

Mr. Rogers notes that the longitudinal cracks almost invariably appear on fills and in cuts and in groups, indicating that local conditions cause them. He attributes them largely to settlement in

MACK ROAD *in* 1913, *village of St. Clair Heights, Wayne County, Michigan. Resurfaced with a bituminous surface in* 1912.

fills and to water and frost in the subgrade in cuts, and shows conflicting evidence on the proposition that a width greater than 12 feet invites cracks unless the pavement is thickened to correspond, the preponderance on Wayne County roads being against the claim. Holes are attributed to foreign matters in the concrete and inferior stone. He considers the pitted condition of the roads to be the most serious defect and to require the most constant attention for maintenance. These defects are due to defective materials and methods in building roads and not to the concrete principle itself, and he therefore considers that Wayne County has made no mistake in choosing concrete as a paving material for its main roads.

It may be added that the better condition of the roads of later construction seems, up to this time, to be due quite as much to better materials and methods as to shorter time of subjection to wear and elements.

Mr. Green agrees very well with Mr. Rogers regarding the use of concrete on county roads, tho he limits its use even then to traffic less than 250 vehicles a day, probably not including automobiles. In the light of the Wayne county experience this limit seems rather low.

Village and city streets being the field covered by Mr. Green's report, he considers the cracks, a proportion of which seem to be unavoidable, to be detrimental to property on account of their appearance. Breaks in the surface cause raveling and these occur with such frequency, in his observation, that they damage both by appearance and by rapid disintegration after the start is made, tho so long as no break starts the surface remains smooth and perfect.

A very careful estimate of the cost of maintenance is made by Mr. Green, based on his observation of the Wayne County roads. He computes the amount of sand and tar necessary to fill cracks, joints and holes of length and size observed and makes other more general estimates which produce a total estimated cost of

maintenance in 1912 and 1913 of $9,051.22. If the whole mileage is considered, this averages nearly $140 a mile for the two years, or $70 a mile per year. The data on which this estimate is based are not exact and some of the estimates are general acts of judgment so that it will be necessary to await further reports, especially the one for 1913, before accepting these estimates as very close approximations to the truth. It is evident that the cost of the experiments made in surfacing concrete with tar and sand should be considered largely as a maintenance charge, and care should be taken to include all expenses which belong to repair, including a proper proportion of the overhead charges. The reports of the Wayne County commissioners are quite full and their assignment of charges to construction, reconstruction, maintenance, repair and experimental work can be checked up readily. The report for 1913 will be read with interest, for it is evident that this is the first year in which maintenance charges have been large enough to be taken into serious consideration, except some resurfacing of roads with bitumen, the cost of which is charged in the reports to improved construction when it should be charged to maintenance and repair.

Civic Center for Boise, Idaho.

A general plan for a civic center for Boise, the capital of the state of Idaho, has been proposed by J. B. Marcellus, assistant city engineer, which avails itself of existing buildings and open spaces and of buildings proposed for early erection in a very ingenious manner, so as to reduce the extra expense of the strictly ornamental features to a minimum and interfere with no existing building which can remain in its present condition for an appreciable time.

The center of the plan is an area two blocks square, half of which is now occupied by the state capitol and its grounds. The postoffice now stands in one quarter and it is proposed to build a new court house in the other corner. By parking the entire four blocks a handsome setting for three good public buildings is obtained. The United States government needs area for extensions of the postoffice and the sale of the present court house site and its inadequate and dilapidated building will furnish funds to purchase the new court house square.

At one side of the state capitol is Columbian park. It is proposed to sell the present city hall and site, which is rapidly being outgrown and to use the money in buying a half block between the park and the city library, thus putting these two buildings into a park with an area of two blocks bordering the four-block central civic center for one-half its length.

In the blocks filling the two reentrant angles of the two parts of the civic center area are several semi-public buildings, such as churches, G. A. R. and Elks' halls and theater, and other churches border Columbian park. Locations for proposed new buildings, such as K. of P., Masonic and Odd Fellows' halls, fill the spaces as yet unoccupied or covered with inexpensive and comparatively unsightly buildings.

Boise real estate is as yet cheap enough to make such a plan as this possible at no extra cost, but if there is delay in proceeding toward the acquirement of the necessary land, business developments with their new buildings and necessities fixing elsewhere location of some of the semi-public buildings now in contemplation, will put insuperable obstacles in the way.

Not all the construction proposed will be carried thru at once, but the lands can be acquired or definitely set aside so that the plan in general can be carried out within a few years. It is seldom that a capital city has so favorable an opportunity to beautify itself without extra cost.

WATER STERILIZATION BY ULTRA-VIOLET RAYS

A Process which Eliminates the Necessity of Adding Chemicals in Order to Purify Water. Sterilization is Produced by a Machine Making Use of the Actinic Rays in Light.

By James A. Seager, Bristol, England.

THE purification of drinking supplies is becoming so thoroly well recognized as a necessity in modern urban existence that very little need be said to urge the importance of a consideration of the subject. Reference may at once be made, therefore, to what is probably the newest form of water purification in existence, and one which appears to be giving some most remarkable results. This is the sterilization of water by means of ultra-violet rays. In this treatment the water is made to flow past a source of ultra-violet rays, this source being a mercury vapor lamp. The water is not in contact with the burner, but is made to flow very close to it, and a number of baffle plates are arranged in such a way as to make the water pass several times under the influence of the ultra-violet rays. In this way a sufficiently long exposure is given to cause the destruction of all the microbes contained in the water.

Sterilization in this way can be effected either by a bulk process such as would be adaptable to main water supplies, or by treatment for each household in a somewhat similar way to that in which water is filtered by the older process after emerging from the tap. It may perhaps be advisable to study the subject from the latter point of view first, in order to obtain a definite idea as to the construction of the apparatus.

Fig. 1 shows diagrammatically the arrangement of a small unit apparatus of this description. It consists of a cylindrical enameled tank 12 inches in diameter and 20 inches high, and weighing 24 pounds, which is equipped with two drain taps RR, terminals, marked + and — to indicate their polarity, fitted in the cover of the tank, and a tilting device for starting the lamp. This has a 110-volt quartz mercury vapor burner controlled by means of an electric switch. In series with the switch is a rheostat regulating the tension of the current, and a 110-volt electric bell is so connected as to ring whenever the current is switched on and the burner is for any reason put out of circuit, ceasing to give its ultra-violet rays.

The sterilizer is mounted on a cast-iron bracket and has an output which varies with the quality of the water treated. For example, with water which is perfectly colorless and transparent, an output of 130 gallons per hour can be obtained. This is the normal result in large towns, but in some cases the water to be sterilized is colored or contains finely divided solid matter in suspension. In such cases it is advisable to subject the water to a filtering process or to reduce the rate of sterilization. The consumption of the burner is 3½ to 4 amperes. If only alternating current is available, a rectifier is added in order to convert the alternating to direct current.

Fig. 2 shows a much larger type of sterilizer, the water being agitated under the light of a mercury vapor lamp, so as to turn any dust particles over and over, as these might form an obstacle to the ac-

tion of the rays on the microbes hidden underneath them. In order to make the system safe an electric connection is made between the quartz lamp and an automatic valve, so that should there be any accidental interruption of current this automatic valve acts and prevents the untreated water from entering the main containing the sterilized water.

Several municipal water supplies in France are using large sterilizers such as the one shown, which is made by Messrs. Philip J. Bertin & Co., of London, with most satisfactory results. These plants represent a total capacity of over ten million gallons per day, while the smaller

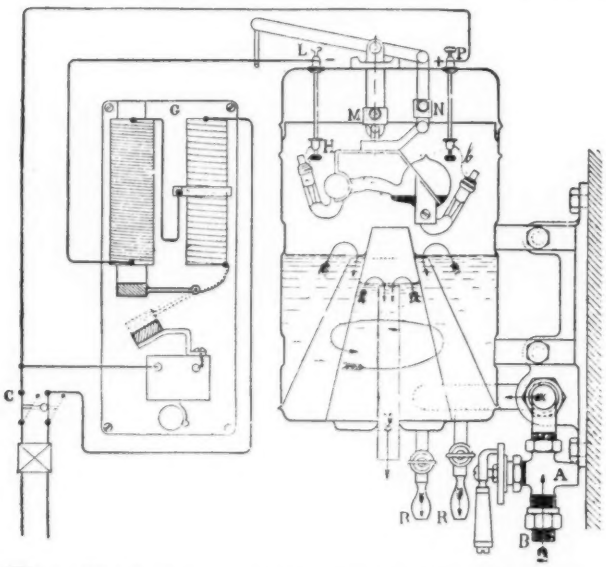


DIAGRAM *of small violet-ray apparatus, showing machine attached to tap to purify domestic water supply.*

sterilizer, shown in Fig. 1, made by the same firm, is in operation in numerous hospitals and other private and industrial concerns.

Many problems of modern hygiene are solved by the use of perfectly sterilized water, and it is often desirable and never disadvantageous to retain the salts and gases which the water contains in solution. The treatment described above does not precipitate the soluble salts, and in no way modifies the physical and chemical qualities of the water treated, the only effect being that the noxious germs are destroyed. For the use of surgeons, physicians, dentists and chemists, sterilized water is necessary, as by its use the need for antiseptics is reduced to a minimum.

Industrially, water thus purified can be advantageously employed for the manufacture of beer, artificial ice, mineral waters, and other commodities, while for washing bottles which are to contain milk, cider, vinegar, etc., it is very valuable. Research has shown that the use of sterile water for the washing of butter has a wonderful effect as, after being washed with water treated by ultra-violet rays, butter was kept for a month without suffering any deterioration.

When applied to the larger purposes of the community in general, hygienists are demanding greater purity than filters are usually able to supply. The addition of chemicals helps filtration, but the precipitants have at times not a toxic but a physical effect on the microbes, mechanically dragging them into the filter bed. The ultra-violet rays have a bactericidal effect, similar to that of sunlight.

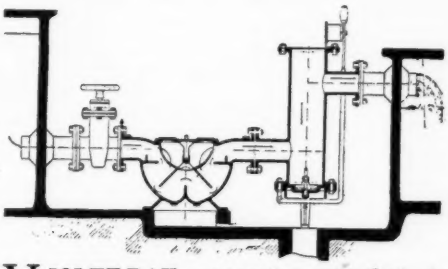
In some tests taken by Messrs. Henri, Helbronner and Von Recklinghausen at the Sorbonne University, it was found that water infected with bacterium coli was freed under the influence of a 220-volt, 3-ampere Westinghouse silica lamp within a second at a distance of 4 inches, four seconds at 8 inches, fifteen seconds at 16 inches, and thirty seconds at 24 inches. Ice, if as transparent as water, may be sterilized in practically the same time as liquid water.

The various classes of microbes are not equally sensitive to ultra-violet light. Taking for example, coli at 15 to 20 seconds, cholera is annihilated at 10 to 15 seconds, typhoid 10 to 20, dysentery 10 to 20, staphylococcus 5 to 10 seconds, pneumobacillus 20 to 30 seconds, subtilis 30 to 60 seconds, and tetanus 20 to 60 seconds.

It is essential not to interpose glass between the rays and the water, as glass is practically an absorbent of ultra-violet light. A small air space must, however, be left between the lamp and water, as if the lamp touches the water directly its temperature would be considerably lowered, and its electrical characteristics would be changed to such an extent that the light emission would be reduced, with a diminution of sterilizing action.

Taking account of the speed of the water and the energy consumed by a lamp, it is found that with 160 to 165 watt-hours per 1,000 gallons, water infected with 5,000 coli germs per cubic centimeter, can be rendered absolutely sterile. The water has, however, to be as clear as possible in order to obtain sterilization with as low a consumption of energy as possible.

In some tests taken by W. T. Burgess, F. I. C., on the eastern district supply of the London Metropolitan Water Board, England, tests were taken, first of all, on ordinary water supply from the main and then on artificially polluted water. In these tests the small type sterilizer was used, the rate of delivery being adjusted to 100 gallons per hour when the mercury lamp was turned on. After the apparatus had been working continuously for 80 minutes, samples of the water before and after exposure to the ultra-violet radiation were taken for bacteriological examination, with the results shown in Table I.



VIOLET-RAY *apparatus attached to supply pipe, with agitator, to sterilize small public water supply.*

With reference to the second column, last item, the organism found in the 10 c. c. test did not give the cultural reactions of typical coli.

On making the test with artificially polluted water, it was arranged that a very large number of organisms should be present in the water passing to the apparatus, but at the same time, the water was not only free from visible turbidity, but also did not contain any undue proportion of soluble organic or coloring matter. In preparing the water, the urban district supply was mixed with a small and constant proportion of a very highly

TABLE I.

	Water from main passing to sterilizer.	Water as delivered by the sterilizer
Organisms capable of growing on gelatine peptone medium in 4 days at 20 deg. C.....	16 per c. c.	0 per c. c.
Organisms capable of growing on agar medium in 20-24 hours at blood heat...	4 per c. c.	0 per c. c.
B. coli and coli-like organisms.....	present in 10 c. c.	Not found in over 300 c. c. submitted to tests.

TABLE II.

	Eastern District water	Polluted water applied to sterilizer
Appearance when viewed in a clear glass vessel in a good light.....	perfectly clear	perfectly clear
Color meter reading.....	11.	13.
Oxygen cons umed in 4 hours at 26.7 C., (80 F.) parts per 100,000.....	.058	.063

polluted water containing organisms derived from tidal Thames water, a sewage effluent, and blood heat broth cultures of microbes obtained from fresh sewage matter. The polluting liquids and cultures were all filtered thru best Swedish filter paper before addition to the large volume of water from the main. Table II gives a comparison between the normal supply and the polluted water.

It is stated that the small differences between the two sets of results are well within the limits often observed in analyses of the Eastern District water itself during the summer months.

After the apparatus had been fed with the artificially polluted water at the rate of 100 gallons per hour for 80 minutes, samples were taken for bacteriological tests, the results being shown in Table III.

It appears from the results that the rate of 100 gallons per hour was somewhat too high for complete sterilization of the artificially polluted water used in the experiment, but at the same time the results afford a remarkable proof of the enormous bactericidal power of the ultra-violet radiation. There is no doubt therefore that this practical outcome of the study which Finsen first made of the biological effect of the ultra-violet light is a matter of extreme importance from the practical standpoint of insuring sanitation and prevention of disease in large communities.

TABLE III.

	Artificially polluted water applied to the sterilizer	Artificially polluted water as delivered by sterilizer
Organisms capable of growing on gelatine peptone medium in 4 days at 20 deg. C.	11,000 per c. c.	12 per c. c.
Organisms capable of growing on agar medium in 20-24 hours at blood heat...	5,200 per c. c.	10 per c. c.
B. coli and coli-like organisms.....	Over 1,000 per c. c.	Present in 10 c. c. not in 1 c. c.

Traffic Suitable for Various Road Surfaces

The Massachusetts Highway Commission, after some years of study and experiment has made the following statement of the effect of traffic on roads and the necessity of legislation governing the relation of width of hard tires to the loads carried by them:

A good gravel road will wear reasonably well under a daily traffic composed of 50 to 75 light teams, 25 to 30 loaded one-horse vehicles, 10 to 12 loaded two or more horse-drawn wagons, and 100 to 150 automobiles. With a larger number of automobiles, the gravel should be oiled. The oiling presents what is spoken of as a "blanket surface" consisting of heavy asphaltic oil and sand. If the oil be applied hot, the blanket surface will last 3 to 5 years, if cold, it must be renewed every year.

Oiled gravel will stand fairly well under 75 to 100 light teams, 30 to 50 heavy one-horse vehicles, 20 heavy wagons with two or more horses, and 500 to 700 automobiles daily.

Waterbound macadam will stand under a daily traffic of 175 to 200 light teams, 175 to 200 heavy one-horse vehicles, and 60 to 80, perhaps more, heavy wagons with two or more horses. If even 50 to 100 automobiles per day go over the road at high speed dust-layers will be serviceable. With a really good dust-layer the road will stand 300 to 500 automobiles a day, altho the stones will wear.

Waterbound macadam with an oil and sand blanket, applied hot, will be economical with 150 to 200 light teams, 75 to 100 heavy one-horse vehicles, 25 to 30 heavy wagons with two or more horses, and automobiles, up to 1,400, or more with fewer teams and with 50 or more motor trucks. The large number of automobiles seems to keep the oil rolled down when it would cut up and crumble without this traffic.

THE NEW CITY HALL OF SAN FRANCISCO

By Bakewell and Brown, Architects, San Francisco, Cal.

One of the notable failures in the planning of city halls is the proper co-ordination of the offices of the various departments so that they shall be convenient for the use of the public and also for the inter-communication of the employes in departments which must be constantly in touch with each other.

Some departments have little business with the public and they should be relegated to upper floors so that the public generally will not be obliged to use elevators or stairways. Other departments have fewer visitors from outside but must have constant intercommunication.

Too often the convenience of the occupants and the visitors is wholly neglected in the effort to obtain a monumental structure. Too often the convenience of one class is considered to the exclusion of the other. Too often the relative importance of various departments is overlooked so that re-arrangements must be made after the building is first occupied. The best results can be obtained only with careful study after frequent consultations with experts in the actual operation of the departments to be housed.

This brief article by John Bakewell, Jr., of the firm of architects which designed the San Francisco City Hall, states the principles upon which the arrangement of offices in this monumental building was based, and the supplementary descriptions of the floor plans will show, with the plates, the manner in which these principles have been applied. The building is so large that the reproduction of the drawings must be upon a very small scale to be brought within the limits of these pages.

THE building has four entrances one from each of the side streets down to the basement level and one main entrance from each of the two principal streets up to the first floor.

The elevators are grouped back of each of these two main entrances, two batteries of three elevators each for each entrance, making twelve in all. The offices with which the public has most business to transact are all located on this floor.

On one side the tax collector is placed between the assessor and the auditor and treasurer, this being the natural order, as the assessor makes out the bills, the tax collector collects the money and the treasurer receives the same from the tax collector and pays all bills, which have to be passed by the auditor. This completes the financial group.

On the opposite side is the recording group; hall of records, registration, bureau and civil service. There is no special connection between the units of this group, but as they must be very accessible to the public all are placed on this first floor.

On the second floor is placed the administration group. The council chamber is at the head of a monumental stairway. On one side of this are the supervisors' chambers with the city attorney and other minor offices completing this half of the building, while on the other side are the rooms of the board of works and the school department with the mayor's suite joining the two sides. This arrangement is the natural one, as the mayor must be in close touch with the board of works and the attorney and the supervisors with the attorney and the board of works.

On the third floor are located the justices of the peace, the county clerk and the engineering department. These departments have no very close connection with the rest of the departments.

On the fourth floor are located the superior courts, clerk of courts and the law library and law college. These departments were placed upon this floor as

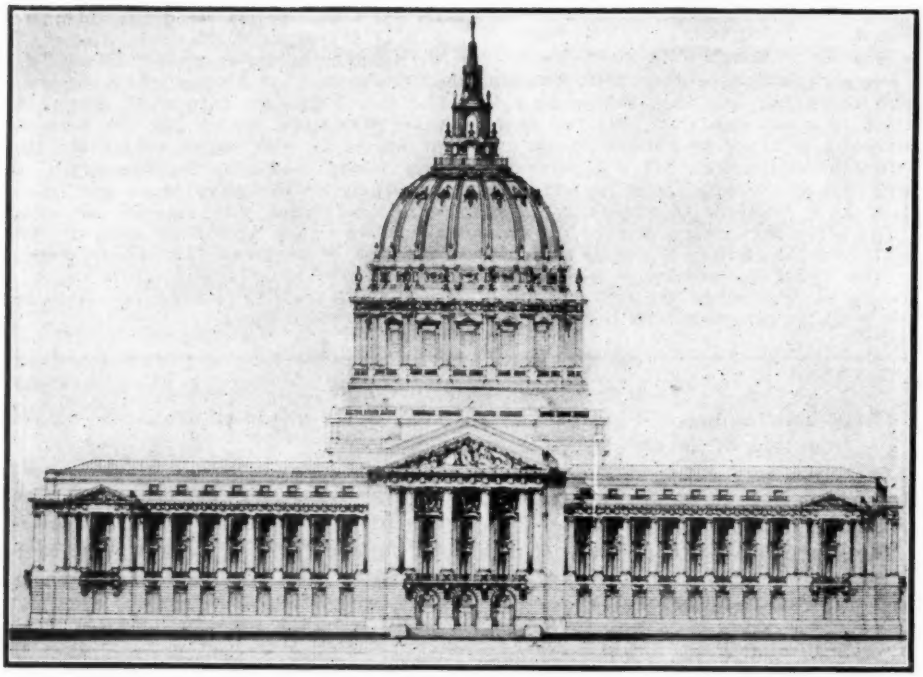
their connection with each other is close, but their connection with the rest of the building is unimportant.

The departments on each floor are connected with general corridors while the whole building is unified by the central rotunda.

The following detail of the lay out of offices, is added by the editor in description of the accompanying cuts showing floor plans.

The main floor has two entrances, on the east and west sides of the building, from Polk street and Van Ness avenue. In the center, between them, is the rotunda, extending the full height of the building, from which the offices open. On the south side is the tax collector's office, with a large public space, counters at the east and west ends of which give space for the booking and license departments and a bank counter on the south side with screens and glass windows to the screened spaces for each of six or more cashier's and assistant cashiers gives ample room for taking care of a large crowd of tax payers. This public room has a height of two stories and a skylight open to the light court. Back of the public room are the desk room for clerks and the private offices of tax collector, deputy, stenographer, bookkeeping department and the sorting room. There are numerous vaults for cash, books, storage, etc.

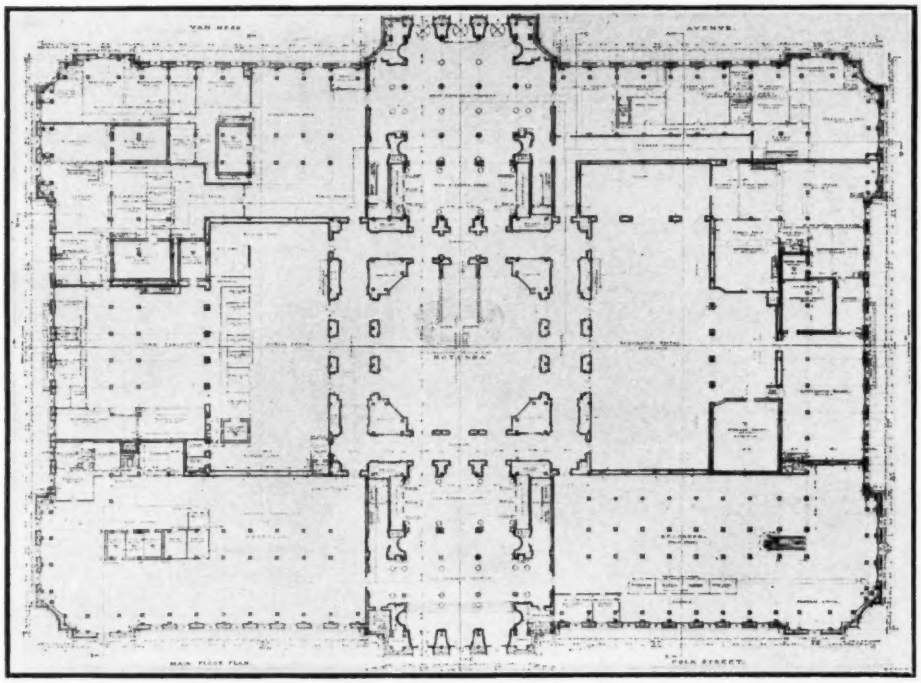
In the southeast corner is the assessor's office with entrances from the east vestibule and from one corner of the rotunda, with public counters for the personal property and real estate departments, but mainly devoted to the desks of the clerks and draftsmen, with vaults for records and two or three small private offices. Light shaft opens over the real estate department. Space for offices for the cashier, stenographer, coin vault and passage is taken from the tax collector's rectangle, alongside the assessor's private office. There is also a private stairway to the basement, and a toilet room. There is no direct connection between the quarters of the assessor and those of the tax collector.



POLK STREET *elevation of San Francisco's new City Hall.*

November, 1913

On the west of the tax collector, with windows to the south, are the quarters of the treasurer, consisting of the small public space lighted by a light shaft and leading to the railed and screened compartments of the entry, bond and receiving clerks and the cashier, behind which is the counting room. Connected with the cashier's quarters is the cash vault, which is separated entirely from the walls of the tax collector's office which parallel it on two sides. Next to Grove street on the south with light from the



MAIN *floor, containing offices which the public in general must visit. Tax Collector, Assessor, Auditor and Treasurer on south side; Recorder, Registration Bureau and Civil Service Department on north side.*

windows are the treasurer's and attorney's offices with ante-room and passage connecting with the tax collector's office, and the general office of the clerks of the department. The treasurer's office has two private stairways and a private lift connecting with additional storage and vault room in the basement. Still further to the west is the room for the treasurer's bookkeepers, connected with its book vault.

The auditor's quarters occupy the remainder of the southwest corner. All visitors of the auditor and treasurer enter the public space of the auditor either from the west entrance vestibule or the southwest corner of the rotunda, those having business with the treasurer passing to the south thru a door in the partition separating the treasurer's quarters from those of the auditor. This is also the only door of communication between the treasurer's and auditor's quarters.

The main office of the auditor is separated from the public space by a large counter, and has a large book vault. The deputy's office is in the northwest corner. The record, statisticians', bookkeepers', auditors', meeting and redemption clerk's rooms are reached by a passage around the book vault, all but the last named office being ranged along the west wall with windows opening to the west.

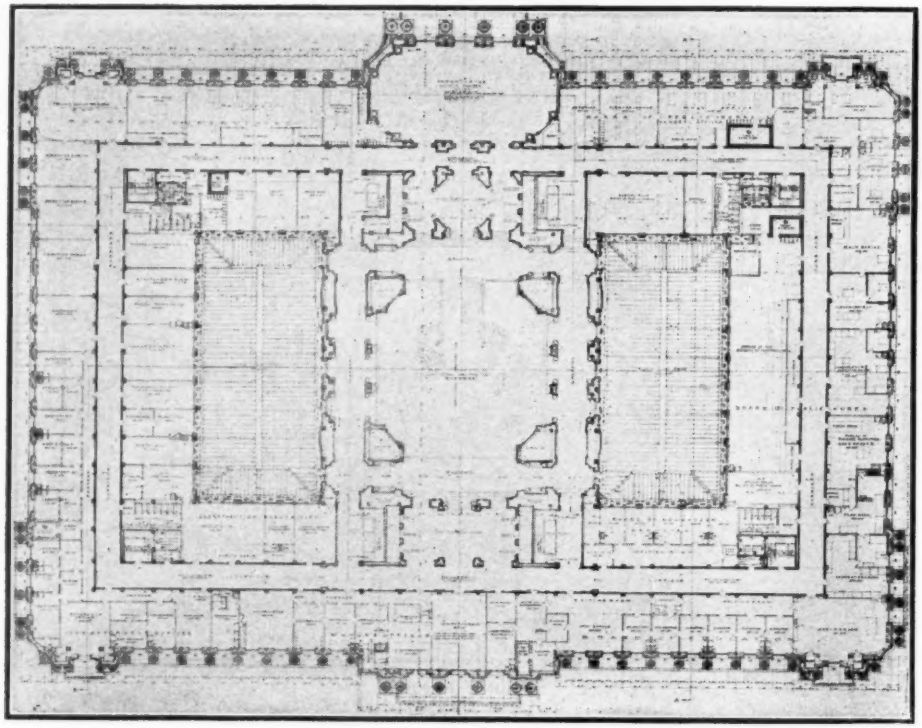
The record, statistician's, bookkeepers', corner with a large public space and stairway to the basement, lighted in part

by a light shaft. Along the east wall is space for the general office behind a counter with screened and windowed areas for the information, blotter, cashier and work rooms. The recorder and his deputy have small private offices.

The north side of the rotunda opens by several doors into the large public space of the registration bureau which has counters with narrow space behind extending round every available space. North of this are storage vault, affidavit room and vault, clerks,' commissioners' and main offices and information bureau, the latter having a public entrance (lighted by a light shaft) from the west entrance vestibule thru a corridor used in common with the civil service department.

This civil service department is ranged along the west wall with entrances from the corridor just mentioned and into the main office from the west entrance vestibule direct. The offices are assigned to the commissioners, with meeting and ante rooms, lobby and store room, secretary, clerks, stationery and printing and record vaults.

These three departments in the north half of the first floor have no connections with each other and are very nearly independent of each other, but each of them has business with many citizens, especially the first two and each has stairways to further quarters in the cellar.



THE *second floor of the City Hall contains offices of Board of Supervisors and its council chamber, the Mayor, City Attorney, Board of Education and Board of Public Works.*

Each department on this floor has its own private toilet rooms, much ingenuity having been exercised by the architects in supplying them without encroaching on office space.

Second floor rooms are lighted either from the outside or from the large light courts above described and the four small light shafts near the outer corners, the rooms being arranged on both sides of a

corridor running entirely around the building.

The council chamber of the board of supervisors occupies the space over the west entrance vestibule and is two stories high, the offices and committee rooms extending round the southwest angle of the building.

The Mayor's offices are over the east entrance vestibule and extend to the south along the east wall and include seven rooms and passage connecting them.

The city attorney's offices, twenty or more in all, including library, are arranged around the southeast corner.

Around the south light court are the department of electricity, playground commission, public telephone station, stationery, committee, press, library and filing rooms.

The board of education occupies both sides of the east corridor north of the center, and the board of public works occupies the north rooms and those on the west, north of the council chamber.

The departments under the board of public works to which rooms have been assigned are the bureau of maintenance along the north light court and the building inspection, assessment and inspector, general office, stenographers, attorney, and commissioners and secretary in smaller rooms and suites.

The third floor is devoted to the county offices, sheriff, county clerk, justice courts in the south half and the east side of the north half.

The bureau of architecture occupies the north side between the light court and north wall with one large and two smaller drafting rooms and four small offices. The offices of the engineering department occupy the northwest corner, apparently using the drafting rooms in common with the bureau of architecture. To one unacquainted with the distribution of duties and location of division officers the space devoted to the engineering department seems small, particularly the filing department.

The fourth floor is similar in plan to the second and has court rooms arranged along the outside walls and court rooms, secretary's offices, judges' chambers, jury, reporters' and rest rooms around the light courts. The law library occupies much of the west side.

The plans of the third and fourth floors are not reproduced as they are so special in their plans and so similar in general lay out to those of the second floor and in part of the first. The three upper floors are supplied with four toilet rooms each on the inner sides of the corridor, cornering on the light courts and each one lighted by a light shaft which also gives light to the corridor. Service stairways between floors give passage between related departments on different floors.

More than usual attention has apparently been given to the proper lay out of offices and their operation after construction will be observed with interest. It is expected that the building will be occupied before the Panama-Pacific exposition opens in 1915.

West Virginia Needs Good Roads.

West Virginia has the distinction of being the only state which abandoned a state highway system and commissioner after having established them. The need for good roads has led to the establishment of a state road bureau in the railway and highway department of the State University at Morgantown, with A. D. Williams as the chief road engineer. The university is prepared to test road materials, and offers a special course in road building and maintenance for road engineers and superintendents. Mr. Williams is trying to interest the members of the county courts, who have the roads in charge, in better methods of maintenance and construction, supplying the need for advice and assistance which the discontinuance of the official state highway department has left.

PROPER CONSTRUCTION OF ROAD EMBANKMENTS

Practical Contractor Illustrates the Serious Effects of Careless Filling.

By GEORGE C. WARREN,
Before The American Society of Municipal Improvements.

At the Detroit Convention of the American Society of Municipal Improvements six years ago the writer read a paper on "Back Filling Trenches." Altho it was well received and favorably published in the engineering papers and quite widely circulated in pamphlet form, it is extremely doubtful if it has resulted in any considerable extent of reform in the long established general custom of letting the trenches "settle" themselves. Certain it is that the careless method is still the rule and we still commonly see the result of "settled" pavement laid over such carelessly filled trenches six months to twenty years after the laying of the pavement. The following item was published in August, 1913, in daily and engineering journals. the italics being inserted by the writer:

"Large Paving Work Poorly Done.

Philadelphia, Pa.—Because the material used to make the fill to bring the Southern boulevard up to grade *was not allowed to settle before the surface improvements were added,* it will be necessary to do over again much of the work on which the city has already spent $761,000. The highway bureau chief says the added expense of re-filling on the *boulevard, which has sunk two feet;* the relaying of concrete and resetting of conduits, man-holes and light posts, will prevent the job being completed with the $210,000 now available for the work. *The contractor shifts the blame to the ex-mayor, who, while in office, ordered the improvements put on the surface before the fill had settled. The bureau chief says that the principal filling material used was household ashes and in consequence there was much settling.* Concrete curbs and sidewalks, brick gutters and macadam roadways, electric light poles, inlets, etc., *were placed on top of this fill immediately after it had been thrown in place and before it has had a chance to settle.* The result is that these costly curbs, sidewalks, gutters, etc., are ruined and it will be necessary to throw away a great portion of this expensive surface work. Replying to the bureau chief's criticism, the contractor said *that the filling of the boulevard was done with clean ashes, earth and gravel, the very best fill to be had, strictly in accordance with the specifications.* The settlement of the paving and curbing and the finished street on top of this fill was due to the fact that *several hundred thousand yards of filling were placed in one year, without giving it the usual time for settling. The mayor ordered the paving and curbing to be done on this green fill, which was about 20 feet deep, in the same year. Under ordinary circumstances the fill would have been allowed to lie from at least six months to a year for settlement before the paving was done.* It was not so in this case, as the government officials at the navy yard were threatening to stop improvements unless the city gave them a finished street leading from the navy yard gate up to the city, and the mayor ordered the work done at once to satisfy the government officials, and said he was willing that the city be responsible for

MONTFORD AVENUE, *Asheville, N. C., looking west. Fill, 19 feet deep in center of roadway and 45 feet on right side. Fill made and bitulithic pavement laid in 1906. No settlement to September, 1913, when this view was taken.*

settlement under the circumstances, and added that the city would not be a party to stopping improvements at the navy yard."

This affords text for a flood of serious thought on another phase of the earth "settlement" problem. The Philadelphia case differs from thousands of cases which occur nearly every day in nearly all cities only in the magnitude, involving construction costing three-quarters of a million dollars; a fill 20 feet deep; several hundred thousand yards of embankment and the many miles of curb and roadway surface.

It is proper to say that the present highway bureau chief was not in any way connected with the Philadelphia public works department at the time this work was done. It should be specifically noted that, according to the report quoted above, the engineer says the fill was made with improper material, "household ashes," while the contractor says sound material was used, "the very best to be had," "strictly in accordance with the specifications," and undertakes to shift the responsibility on the poor ex-mayor who ordered the work completed promptly to avoid "stopping improvements at the navy yard."

Apparently it never occurred to any one during the period of drafting specifications and construction of the work to see that the work be done in such a way that there could be no subsequent settlement even at the expense of a little more money in original construction. Is not such neglect almost criminal?

More than 20 years ago in connection with a paving contract in Utica, N. Y., the writer had charge of the making of an embankment about 500 feet long, 50 feet wide and up to 6 feet deep. This was in a roadway extending across what is known as "The Gulf," a ravine about 75 feet deep extending thru the city, being the bed of Ballois creek, once an important stream but now a nearly extinct branch of the Mohawk river, at the junction with which old Fort Schuyler was located in the French and Indian war period. As the city grew towards "The Gulf" it had become filled with ashes, tin cans and general refuse, in face has been the dumping ground of the city for many years, the fills being made opposite the street ends. Altho made of improper material the filling was so

gradual that the embankment packed under traffic as it was made and, as above stated, at the time of paving was up to within almost six feet of the proposed sub-grade of the pavement. Could this fill be made quickly so that pavement could be laid immediately and without any settlement of the pavement? It was so made by the simple process of hauling the embankment material to the fill; spreading it in layers about 6 inches deep and thoroly rolling until solid, dampening the earth slightly with a watering cart at times when it was too dry to pack.

In connection with the laying of bitulithic pavements on French Broad avenue in 1904 and Montford avenue in 1906 in the city of Asheville, N. C., the grade, alinements and widths of the streets were materially changed, necessitating heavy cuts and fills. In some cases the entire width of the roadway was raised from 6 feet to 19 feet. In others, where the roads passed through ravines, the straightening and widening necessitated side-hill fills about 30 feet wide and from 20 to 25 feet deep. At some extra expense a 12-ton steam road roller was lowered to the bottom of the ravine, a road built for descent of wagons to the bottom and then the embankment proceeded as all embankments should, in layers thoroly rolled from the bottom to the top. Here again there was no subsequent settlement and the fill was not "allowed to lie from at least 6 months to a year for settlement before the paving was done," as the Philadelphia report says would have been allowed "under ordinary circumstances." Such a fill made according to the Philadelphia practice might continue to settle, slip and slide for 10 years, no one could tell how long.

The writer is indebted to Mr. J. T. Bostic, street superintendent of the city of Asheville, for the accompanying photographs of the French Broad avenue and Montford avenue fills and for a clear description of the conditions as follows:

French Broad Avenue Fill:

"The fill was made by Warren Brothers Company in 1904. The old street was nearly 24 feet roadbed and widened to 56 feet. We raised the old fill 6 feet high. On the west side the fill was 35 feet high when completed. There was a large storm sewer thru this fill. We began at the slope of the 35-foot fill on the west side, filling from the 56-foot slope 1 foot at a time and rolling thoroly every 12 inches until finished. On the east side

SIDE *view of 45-foot fill on Montford avenue, Asheville, N. C.*

SLOPE *on fill along Elm avenue, Baltimore, Md., looking towards Fourth avenue, from Thirty-fourth street. Fill 25 feet deep and 60 feet wide. Pavement laid in* 1908; *view taken September,* 1913. *No settlement of fill, which was laid in layers and thoroughly rolled.*

the fill was 20 feet high and was filled the same way. The filling, paving and setting of curb was all done within three months and there shows no sign of any settling whatever. Photograph No. 3 was taken at the foot of the hill looking north. You will see by the photograph that there is no sinking at all in this street.

Montford Avenue Fill.

"The Montford avenue fill was made by the Atlantic Bitulithic Company in 1906 and was an old street car track and a fill 14 feet wide on top and 26 feet high. We widened said street to 50 feet, making a fill 45 feet high when finished, filling 1 foot at a time at the foot of the slope and rolling up until street was completed, making a fill 19 feet higher than the original old street car fill. This shows no sign of sinking at all since original street was made and paved. Photograph No. 1 looking west, and No. 2 at the foot of the hill."

In the year 1907 in connection with the laying of pavement on Charles Street Avenue boulevard, Baltimore, Md., a side hill embankment was necessary quite similar to that in Asheville above described. In this case Warren Brothers Company's connection with the work was as a subcontractor laying the bitulithic surface only. The specifications required that embankment be made in 6-inch layers thoroly rolled. The general contractor insisted that the fill must be made from the top down, he claiming that wagons and roller could not be practically lowered to the bottom of the ravine. The engineer sustained the general contractor, who then proceeded to build a construction track at the top and make the fill with dump cars from an adjoining hill—a very cheap embankment but very expensive result. Fortunately in this case, before the pavement surface was laid, but after the foundation and curb were complete, "the rains descended and the floods came and beat upon" that fill and it slid several feet toward the bottom of the ravine. The general contractor fumed; blamed everyone but himself and even charged the result to the sub-contractor for the pavement surface on the remarkable theory that, if the sub-contractor had more promptly surfaced the

foundation the water would not have entered the fill and it would not have settled. One side of the street was then barricaded for more than a year waiting for the embankment to settle, to the great annoyance and inconvenience of all concerned, including the public and owners of abutting property.

A year later a condition arose in Baltimore in connection with the paving of Elm avenue, which was quite similar to Charles Street Avenue boulevard except that on Elm avenue the conditions were such as to make more difficult the lowering of the roller and building of wagon road to the bottom of the ravine. In this case the company with which the writer is connected had the general contract and, therefore, was not hampered in proper prosecution of the work. The roller was lowered and the wagon road to the bottom of the ravine was built. The pavement was immediately constructed and there has been no settlement since.

In the paper of seven years ago on the subject "Back Filling Trenches," above referred to, the writer said:

"One engineering journal recently suggested that tamping the earth in back filling trenches be done with pneumatic or steam rammer. This offers food for thought to the inventor. For the present, tamping must be done by hand."

The food for thought has borne successful fruit in the development of the Staley mechanical tamper, a most useful, simple, inexpensive apparatus which is in far too little use. The city of Wilmington has one of these Staley mechanical tampers and it is hoped its practical use may be shown to the A. S. M. I. delegates at their convention.

"Eternal vigilance is the price of success," so is this matter of earth settlement, whether it be in back filling trenches or making embankments, let the engineer make specifications requiring first class construction; see that contractors bid prices high enough to enable compliance with the specifications, and then insist on their being carried out in good faith, and we will have no more waiting at least 6 months or a year for settlement before completing the work, nor the other alternative of loss of many thousands of dollars thru subsequent settlement of the completed works.

In conclusion it is the writer's conviction that, whatever the trouble and expense may be, in all cases where fills are

ELM AVENUE, Baltimore, Md., showing pavement laid over fill shown on preceding page. This pavement has been down five years and shows no depression.

made in roads and pavements, whether the fills consist of back filling trenches or embankment, economy and efficiency demand that the work be done thoroly to the end that there will be no subsequent settlement.

If engineers will uniformly not only draft specifications so as to provide for such care but also see that contractors fulfill the specifications, they will be performing one of the most useful reforms in connection with road construction.

It ought not to be necessary to inform contractors in advance that specifications must be complied with, but in this important matter careless construction, regardless of specifications, has come to be so general in practice that it is well to specially and forcibly call the attention of prospective bidders to the condition of the specifications and inform them that they will be rigidly enforced. Let a few contractors pay the penalty of bidding on a basis that specifications will not be enforced, especially in this important respect, and the present carelessness will soon become history and proper construction the order of the day.

Unit Costs on Steam Shovel Excavation

One great advantage of the weekly cost sheets made out on their various jobs by the Aberthaw Construction Co., Boston, is the fact that unnecessarily high costs in any part of the work are detected and corrected before they have gone far. By thus knowing in detail just what such work costs, this company is enabled to make correct bids, where a less informed contractor would be likely either to take the work at a loss or to figure an excessive charge for it.

As an example of this method of cost keeping and its working out in service, an excavation job in New Hampshire, at which 8,022 cubic yards of material were removed from the side of a hill to make way for a building foundation, the cost figured out at 37½ cents per cubic yard. This work was done with a two-third-yard Thew steam shovel, and showed a saving of probably 8 cents per unit as compared with handwork. At the same time, it should be remembered that a great deal of railroad excavation is done at a cost of 5 to 6 cents per cubic yard, and many contractors would have bid 20 or 25 cents on the job in question—and lost money.

An analysis of the figures shows that labor alone (around the shovel, pushing and unloading the dump cars and spreading the material at the dump) accounted for practically 25 cents per cubic yard of total material handled. The items of rental of shovel and track, repairs, etc., were so small that, figuring on these as a basis, a much lower figure than that obtained would have been bid by an inexperienced contractor. This shows in a very clear way the advantage of an exact cost accounting system on jobs of this sort as a guide to future work.

Most of the material was dry gravel with a small percentage of boulders. It was carted off in dump cars pushed by hand back and forth on a standard contractors' track (500 feet) carried on a trestle about 10 feet above the ground. The average haul was about 400 feet; the shortest haul, 200 feet. The unit costs are shown in the following table in cents per cubic yard:

Labor around shovel, pushing cars, unloading, and spreading at the dump	22.9
Repairs, $18.58; rental of shovel, $345.00	4.5
Labor on track, including 10-ft. high trestle	3.5
Labor for unloading, placing, etc., at the job	3.1
Rental of track	1.4
Labor at Boston end (including riggers' bill)	1.25
Freight on shovel and parts (both ways)	0.85
Total	37.5

How the New York Purchasing System was Established

MANY PARTS OF THIS SYSTEM CAN BE ADVANTAGEOUSLY COPIED BY SMALLER CITIES.

By F. X. A. Purcell, Bureau of Standardization of Supplies of the City of New York.

This illuminating exposition of the necessity for standardizing supplies for city departments and methods of purchasing the same is taken from a paper before the Municipal Engineers of New York City and indicates the methods by which millions of dollars are saved to the city.

SUPPLY purchasing has not long been perhaps from neglect, perhaps beconsidered a business proposition, cause regarded as a legitimate means for payment of political debts. Civil service has had more attent ion and has been established very generally altho the pay roll may not be more than five times the amount of the city's purchases.

Awakening has come thru the results of combined buying by large organizations, by long strings of department, grocery, tobacco and ten-cent stores, restaurants and the like. Low prices are possible thru central buying and this argument is irresistible. Business men urge cities to follow these examples as a step toward lowering taxes, a long step in New York, which spends $20,000,000 a year for supplies.

Washington is providing a fireproof warehouse to store and handle supplies purchased by its purchasing officer, appointed after a Congressional report made in 1912. Los Angeles established by ordinance in December, 1912, a store department with purchasing, store and mechanical divisions. Cleveland's purchasing department has saved far more than its cost. Philadelphia has lost some of the greatest advantages of its central purchasing system of several years standing by lack of adequate storage facilities. Chicago has the central purchasing agency and storehouse. Cincinnati began its central purchasing this year.

New York City began its enormous work of standardizing supplies and purchases in 1909 in the establishment of standard specifications by the Board of Estimate and Apportionment for all supplies purchased. A Select Committee was appointed, composed of Mayor, Comptroller and President of the Board of Aldermen, to supervise the work.

An advisory commission of five with Deputy Comptroller Fisher as chairman, was chosen by the Select Committee and the active management was placed in charge of Mr. W. Richmond Smith. The organization built up by Mr. Smith has since been designated as the Bureau of Standardization of Supplies of the Board of Estimate and Apportionment.

卐

¶ UNDER *the old system the same supplies were never described alike by various departments, making inspections almost useless.*

The Departments were and are in the habit of describing the same supplies so differently and so incompletely as to minimize competition and to make inspection of supplies almost useless. They also differ greatly in their choice of articles to be used for similar purposes. It was necessary to establish a definite qual-

ity of supplies for use in all purchases by city departments. Only a city of the first magnitude could afford such a step, and the proper completion of this work by the City of New York will make it unnecessary for the smaller cities because surely no city will find a need for an article not included in the supply list of New York.

The Commission on Standardization of Supplies began work in July, 1910.

The first step was necessarily to compile a list of the articles commonly purchased by the city, taking some one year as a basis, with the amounts expended on each item, so that a classification for contract and accounting purposes might be established, a guide afforded for the choice of standards and a basis furnished for the determination of the relative importance of the items.

Accessible lists of supplies in the offices of the departments were incomplete or were in different terms and it was found practically impossible to create a uniform record of the amount annually expended for each item. No help therefore, could be obtained from these sources. It was necessary to go to the original vouchers on file in the Department of Finance.

卐

IN order to prepare proper classifications for standardization of purchases it became necessary to examine over fifty thousand vouchers.

To undertake this task required courage and patience, for in the year 1909, which was taken as a basis, 50,000 vouchers were paid for supplies and all of them had to be examined. The list, comprising 18,000 items, was completed in the latter part of last year, in card index form, by departments, summarized in schedules, showing the purchases of each item by each department, with prices paid.

As items grew into classes, the classes were named, no arbitrary classes being fixed in advance. As finally corrected they are believed to be a reasonable division of the supplies purchased and such as will admit of the letting of a contract within a single class. The list of classes is printed in every contract form and is no doubt familiar to all. It is as follows:

1. Apparatus (laboratory, etc.)
2. Arms and supplies, ammunition and explosives.
3. Athletic goods (including games, toys, etc.)
4. Books, publications, etc.
5. Cleaning materials and compounds.
6. Cleaners' machines and supplies.
7. Clothing, etc.
8. Cordage, rope and oakum.
9. Drafting and engineering tools, instruments and supplies.
10. Drugs, chemicals, etc.
11. Dry goods, notions, etc.
12. Electrical fixtures and supplies.
13. Fire apparatus and appliances.
14. Food products.
15. Forage (including all food for animals).
16. Fuel (including fuel oils.)
17. Furniture and furnishings (including kitchen supplies and utensils).
18. Hardware (not otherwise classified).
19. Hospital supplies and surgical instruments.
20. Iron, steel and other metals (including castings).
21. Leather, saddlery, belting, hose and hose fittings.
22. Live stock (including horses and all other animals) and laboratory specimens.
23. Machinery and parts (not otherwise classified).
24. Materials of construction (including lumber, timber and building material).
25. Materials for manufacture of prison goods.
26. Miscellaneous.
27. Nails, bolts, nuts, washers, rivets and screws.
28. Nautical suplies (including boats and equipment).
29. Office equipment (other than furniture) supplies and stationery.
30. Oils (lubricating and illuminating), greases and lubricants.
31. Paints, oils, varnishes and painters' supplies.
32. Pipe, valves and pipe fittings.
33. Photographic materials and supplies.
34. Plumbers', steamfitters' and machinists' supplies.
35. Printed, lithographed, engraved and bound books and forms.
36. Rubber goods (not otherwise classified).
37. Stable equipment and supplies.
38. School supplies (not otherwise classified).
39. Seeds, plants, shrubs, trees, etc.
40. Tools and implements.
41. Vehicles (including automobiles, trucks, wagons, carts, carriages, bicycles and motorcycles).

42. Wire rope and wire.

As each class became large enough to indicate the kinds of supplies used, the preparation of specifications was begun.

First a study was made of the different articles used by different departments for the same purpose, and a single standard was presented to all departments for adoption. The standard was not always the best of its kind but was of the sort apparently best suited to its purpose. In no case was the standard such as to limit competition.

When conditions proved it necessary several qualities were provided for, either thru separate specifications or in the same specification.

The cooperation of all departments was earnestly sought and in most cases cheerfully given. It was realized that the special requirements of each department were best known to the department officials and many conferences were held so that these special requirements might be brought out and discussed.

A standard of quality decided upon, the next step was to learn the points which governed its quality in order that they might be described.

卐

¶ A RESEARCH *laboratory was necessary in order to properly establish standards.*

It was in the choice of standards that the need became evident of a laboratory to make research tests and to establish quality grades in the making of specifications and also to enforce the carrying out of completed specifications by the test of samples taken from deliveries. A conference attended by engineers representing the Borough Presidents and by the Chief Engineer of the Board of Estimate and Apportionment, resulted ultimately in the establishment of a thoroly equipped, adequately manned and centrally located standard testing laboratory, by resolution of March 13, 1911, providing for the testing of samples of all kinds of supplies purchased for the city, for auditing purposes; the testing of materials of construction; the carrying on of research work for the benefit of all departments; the supplying to the commission on standardization of the scientific and technical data for the preparation of specifications; the maintenance of central records showing the length of life and the qualities of materials of construction; the issuance of bulletins bearing on these subjects; the furnishing to the corporation counsel of data to protect the city's interests in legal actions.

The activities of the Standard Testing laboratory under the direction of Mr. Otto H. Klein have continuously justified its creation, the choice of standards was simplified and has progressed more rapidly.

卐

¶ VALUABLE *information secured from trade experts prior to the adoption of specifications.*

Trade experts were consulted so that as wide competition as possible might be secured and then the specifications were written. Copies were sent for criticism to all departments interested and to manufacturers and dealers handling the article. Thoro consideration, and if necessary deeper investigation, was given to every criticism received, and not until all were agreed or it was found hopeless to bring them to agreement was the specification submitted to the Select Committee for approval and then to the entire Board of Estimate and Apportionment for adoption.

By the end of 1912, two hundred specifications were thus made effective, covering practically all the commonly used articles in classes 5, 14, 15, 16 and 22 of the above list.

卐

¶ A SAVING *of one cent per pound on meat purchases amounts to* $50,000 *a year.*

It is difficult to estimate the saving in which the use of these specifications has resulted but the conditions corrected convey some idea. A saving of one cent a pound in meat, formerly purchased at prices above the market, results in a

total saving of over $50,000 a year. Forage costs the city about $900,000 annually. The establishment of specifications requiring the official gradings of the New York Produce Exchange has saved the city a considerable sum. There is a caving of six cents per pound on butter, an annual saving of more than $25,000. Seasons were established for the use of fresh fruits, vegetables and fish, preventing the purchase of seventy-five cent strawberries and eighty cent fish. The fixing of weights, of sizes or of quantity per package enforced the delivery of known quantities of fruits and vegetables instead of unknown, "boxes," "crates," and "bunches." These are only a few of the results effected but they serve as illustrations.

While the work on the supply list and the specifications was progressing, the forms of contract used by all departments in the purchase of supplies were examined and a standard form was prepared, embodying their best features, but providing for the letting of contracts under definite class heads and for a uniform type of bid. This form of contract was adopted July, 1912, and was used during the following year. Advantage was taken of the year's experience in modifying the form, which is now in general use.

The work of the bureau up to this point was accomplished by Mr. Smith and his assistant, Mr. Donovan, with a force of small salaried clerks and typewriters never exceeding eight persons.

In September of last year a transfer of funds from the appropriation for the Department of Finance made possible the appointment of the first member of what is now known as the "field staff" so called because the work is mostly away from the office, and which now numbers six, five of whom are engineers. The sole duty of the field staff is the preparation of exact, concise, just and "perfect" specifications of items ranging from nursing nipples to automobiles. If the specifications are not exact and concise, the staff hear of it from Mr. Smith. If they are not just they hear of it from the trade. If they are not perfect, the departmental engineers tell them about it.

There were many civil service difficulties in the appointment of the field staff, the effort being to transfer from other departments men familiar with supplies, either from the purchasing or the laboratory standpoint.

The following principles were laid down for the guidance of the staff:

Specifications shall be in unit form.

No specifications shall mention a manufacturer's name or a trademark.

The words "equal to" shall not be used.

Inexact adjectives shall be avoided.

When possible, tests shall be specified. When two tests are possible, one complete occupying four hours say, the other sufficiently complete to assure the quality specified, occupying say fifteen minutes, the latter test shall always be used.

Except in rare cases, specifications shall not provide for showing or requiring samples.

Since the beginning of the year specifications have been prepared for the following classes in the above list: 1, 7, 8, 10, 11, 19, 20, 21, 23, 24, 25, 30, 31, 34, 40, from two to 145 specifications in a class, making a total of 622 specifications prepared this year, or a grand total of 822 specifications in use.

Of these later specifications, 380 have been approved by the Select Committee and have been submitted to the Board of Estimate and Apportionment for adoption and promulgation.

卐

ONE *of the greatest difficulties in setting up standards was encountered in obtaining agreement between department heads.*

In many cases the greatest difficulty experienced was in bringing department officials to agree upon standards. In all cases, it is believed, a wise choice was made.

Another difficulty was in obtaining reliable information. Most of the merchants and trade experts consulted expressed willingness to assist but, naturally, many were averse to imparting trade secrets. It is behind these trade secrets that trade deceptions lie and considerable effort was expended in unearthing them.

Only in a few cases has it been necessary to provide for the showing of samples. Trade gradings have been used wherever they are well established.

The specifications in their present form are not believed to be perfect. They are the best that can be expected before trial confirms their usefulness or suggests the way to improve them.

Since the beginning of the year work has progressed rapidly in preparing schedules of purchases in 1911 which will add to the list of 1909 such items as were missing.

If proof was needed that the city's method of buying is at present wasteful, it was supplied by the schedules of the purchases in 1909. An examination of the vouchers showed that many vouchers were passed for amounts less than the cost of handling them. Hundreds of vouchers bore so meagre a description of the articles purchased that it was impossible to classify them. Only a small proportion of the contracts or orders were awarded to manufacturers or wholesalers. Discounts for prompt payment were never allowed because they were not earned. Prices paid for the same kind of goods differed as much as 300 per cent. Long lists of supplies were purchased under a single contract or order and paid for in lump sum, making auditing virtually impossible. Items were grouped:—hardware mixed with dry goods or soap mixed with rubber hose, so that no legitimate merchant could bid.

In collecting data for the specifications it was learned that manufacturers, commission merchants and wholesalers have become accustomed to do business with the city thru middlemen, in some cases paying a commission to the middlemen, in others charging regular prices, leaving the middlemen to make what profits they could. This is due to the distaste felt by the greater merchants for business as small and as troublesome as departmental transactions usually are, and because they have felt that the middlemen were possessed of the password that brings city business.

The merchants welcomed the opportunity to enter fair competition and in most cases proved that they could do better for the city than the middlemen can.

Inquiry developed that there are 120 officials vested with authority to buy supplies and that there are more than 2,100 places where supplies are received from vendors and therefore many hundred men intrusted with the power to accept or reject deliveries.

It would take an extended investigation to learn how many men are employed in these numerous places in the purchase, distribution, storing and accounting for supplies. All of the extravagance, the abuses and the waste can be traced to the lack of cooperation between departments and the lack of a central control.

¶ THE *purchasing system used by one of the large railroad corporations studied as a model.*

To learn of these things was comparatively easy, after the supply schedules were started. To suggest the remedy required months of study of the methods of progressive corporations and of the peculiar problems in city business.

The Canadian Pacific Railway was the most studied model because of the great variety of supplies used in its railway, steamship and hotel systems and because of the great courtesy of Sir Thomas Shaughnessy, its president, who instructed his subordinates to give to the city's representatives all the time and all the information required for their purpose.

In February of this year, Mr. Smith presented to the Comptroller a plan embodying the essentials of the Canadian Pacific scheme of routine and records of buying and handling supplies, modified to suit conditions imposed by the charter of New York.

This plan has been printed by the City Comptroller, William A. Prendergast, and a bill has been prepared for submission to the legislature providing the necessary legislative authority for the central purchase and distribution of supplies for the city.

DETROIT'S MUNICIPAL ASPHALT PLANT

By H. B. Pullar, Engineering Chemist, Detroit, Mich.

THE City of Detroit has during the past ten years, maintained and operated its own municipal asphalt paving plant, which plant, during the first eight years of its existence, made an estimated saving of over $200,000.00 to the city. This estimated saving was made by comparing the lowest bids on work obtained previous to the installation of the municipal plant and the actual cost of work laid by the city.

The municipal plant is in charge of Mr. Clarence H. Proctor, a well known and recognized asphalt expert. The asphalt pavements in Detroit are in excellent condition and repairs are never neglected. The condition of these pavements together with the accrued saving during the first eight years, are ample proof of the fact that municipal plants under expert supervision are good investments, and this is especially true in states where the laws permit municipalities to do new work as well as repair work.

The original municipal plant is a Hetherington & Berner, consisting of two mixers, one for binder and the other for top; two drying drums, melting tanks and storage bins. After a few years this equipment was found to be insufficient for the rapidly increasing demand for asphalt pavements and an addition was made to the plant by installing a Cummer drum, tank and mixer. The demand for asphalt pavements continued to increase until during the past year it was found necessary to add an entire new plant which consists of an up-to-date Hetherington & Berner complete asphalt plant. This new plant is of the highest type and consists of two mixers, one for binder and the other for top, two drying drums, two open tanks and two agitators or pressure tanks. This new equipment was installed at an approximate cost of $22,000.00 and the total value of the Detroit municipal plant and equipment at the present time, is estimated at $75,000.00.

The city maintains a laboratory at the plant where the mixtures are tested daily and where all raw materials are carefully tested before being used. The mixture is produced by men of long experience and under the personal supervision of Mr. Proctor, thus insuring a uniform and high grade mixture at all times. As the success of an asphalt pavement depends almost entirely upon the way the materials are handled at the plant, this is of the utmost importance and can be cited as the principal reason for the successful asphalt pavements in Detroit.

Between ninety and one hundred men are employed at the plant. The laborers there receive $2.50 per day, straight time during the paving season, and the experienced men receive pay in proportion to their ability and experience. The plant, while under the direct charge of Mr. Proctor, also has a superintendent, thoroly familiar with the business, who receives a salary of $1,800 per year. The superintendent, time-keeper and book-keeper are the only people retained during the whole year, the rest of the labor, as stated above, being confined to the paving season.

After the mixture has been produced at the plant it is drawn to the streets in forty canvas-covered wagons, hauling two and a half cubic yards each. These wagons cost $155.00 each, f. o. b. Detroit. During the past year, two five-ton asphalt trucks have been added to the equipment. These trucks were made by the General Motors Co. and cost $4,500.00 each.

As has been the general experience thruout the country where trucks are used, they have proved of execptional value for long hauls and have materially reduced hauling charges. Previous to the installation of the trucks, it took from two to three hours to make the long hauls, which

DETROIT *municipal asphalt plant furnished by Hetherington & Berner and operated by the Detroit Municipal Asphalt Maintenance Department.*

are now made by the trucks in from twenty to thirty minutes. The short hauls are still made by wagons, which for such hauls have been found to be more economical than trucks.

The total capacity of the Detroit municipal plant of today is between 2,500 and 3,000 square yards of finished work per day, the finished pavements consisting of 1½ inches of binder and 2 inches of wearing surface. The city will lay between 300,000 and 400,000 square yards of work per year, of which about 25,000 square yards is repair work, including cuts made by the public service corporations. During the present year it is estimated the following quantities of materials will be used:

Asphalt	4,000 tons.
Asphalt sand (for top)	25,000 cu. yds.
Limestone (for binder)	12,000 cu. yds.
Limestone dust (for filler)	2,500 tons.

The cost of these materials f. o. b. plant being:

Sand	$ .72 per cu. yd.
Limestone	.90 per ton.
Limestone dust (In paper sacks.)	3.15 per ton.

The city contracted for 3,000 tons of various kinds of asphalt f. o. b. Detroit, as follows:

	Tons.	At per ton.
Bermudez asphalt	1,500	$28.15
Montezuma Mexican asphalt	1,000	29.12
California asphalt	500	20.50

About three car-loads of asphalt are used each day, and during the paving season over 2,000 car-loads of materials are received and handled at the plant.

The asphalt, after being received at the plant, is stored until ready for use, and when ready it is first stripped and then taken up into kettles by means of a revolving chain with hooks. It is then put into the melting kettles and flux added to bring the asphalt cement to the desired consistency, the flux varying in proportion according to the brand of asphalt used. For the Mexican and California brands of asphalt, about three pounds of flux to one hundred pounds of asphalt is required, and for Bermudez asphalt, about twelve pounds of flux to one hundred pounds of the refined asphalt, the resulting penetration of the asphalt cement being from 50 to 60, depending upon the traffic of the street on which the material is to be used. Craig residuum oil is used for flux and is obtained in tank cars at the price of approximately $11 per ton, delivered.

Coal is used for fuel and is obtained at a price of $2.50 per ton at the plant and the small amount of wood used is obtained at $7.50 per cord.

The asphalt mixture as it is turned out from the plant varies slightly in the per cent. of bitumen, depending upon the kind of materials being used. For the so-called oil or pure asphalts, the standard mixture calls for 11 per cent. of bitumen, while for the so-called natural asphalts, the standard is 10½ per cent. The per cent. of dust also varies slightly, according to the traffic conditions of the street, but is usually maintained at from 7 to 12 per cent.

After the mixture comes from the plant it is taken to three different street gangs, one gang doing repair work, while the other two are on resurfacing and straight new work. Each of these gangs consists of about twenty men as follows:

One foreman		
Four rakers	$3.50	8 hours
Three tampers	3.00	8 hours
One smoother	3.00	8 hours
Two apprentices	2.65	8 hours
Eight laborers	2.25	8 hours
One roller man.....	4.50	10 hours

All of the men receive straight time during the paving season but are released during the winter months. The rakers, smoothers and tampers are all union men, belonging to the Detroit Pavers' Union. They are thoroly experienced in laying asphalt pavements and are big factors in giving the excellent results obtained.

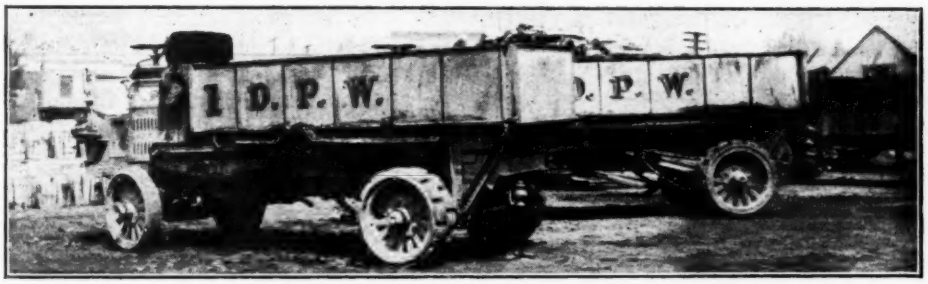
The work of the municipal plant is divided into three distinct classes. The classes and the average cost of the work of each are as follows:

Resurfacing work	$1.13 per sq. yd.
Paving and repaving (new work)	1.05 per sq. yd.
Patching	1.00 per sq. yd.

The apparent high cost of the resurfacing work is due to the fact that considerable of this work is the resurfacing of old cedar block pavements and required about 3½ to 4 inches of surface mixture.

At the end of the present season there will have been laid by the Detroit municipal plant, approximately 1,800,000 square yards of pavement or about 125 miles of asphalt streets.

There are many valuable suggestions to be taken from the Detroit municipal asphalt plant, the principal one of which is the fact that this plant is under the direct supervision of an asphalt expert, a man thoroly familiar with the business and who employs only expert labor, for without doubt a large per cent of the failures of bituminous pavements thruout the country can be attributed to the careless or inexperienced handling of the materials at the plant and on the street and it would be well for engineers and city officials interested in the development and operation of municipal plants, to investigate and absorb the number of good features of the Detroit municipal plant which has proven without doubt to be a success and a very valuable asset to the city.



TWO *five-ton motor trucks used by Asphalt Maintenance Department at a great saving on long hauls.*

Type of Motor Fire Apparatus in British Use.

By Thomas Reece, London, Eng.

ALTHO horses for motive power still figure very largely in the fire prevention service of even the biggest British cities the movement towards the motor engine grows stronger. Several firms are now building fire brigade motors, the specifications ensuring speed, reliability, durability and adaptability for all kinds of roads and emergencies that are in the up-to-date fire engine. One order for the London fire brigade was recently for sixteen such engines; these were of either 60 h.p. or 75 h.p. The Birmingham fire brigade took eight similar models quite recently, and Glasgow five. A turbine pump equipment went with these, this pump being of the centrifugal multi-stage high pressure turbine type. It delivers approximately 400 gallons of water per minute at 120 pounds pressure and will deliver up to 500 gallons per minute at lower pressures, when working thru 100 feet length of 2¾-inch unlined canvas hose. The engines are also fitted with an airpump charging apparatus with a capacity for lifting water from a depth of 29 feet in as many seconds. This apparatus is very efficient as it has two double-acting cylinders, each working independently.

In all these makes a reserve of horse power is allowed for and the makers guarantee that the engines will not have to run "all out" to give the stipulated output. They are equipped for various types of fire escape ladders or chemical first-aid tanks. A description of the 75 h.p. model which is now so popular will not be out of place.

The six-cylinder engine is of enclosed vertical type, cylinders cast separate, valves mechanically operated and placed on opposite sides with pressure feed lubricating system on the latest principle. This engine is 5-inch bore by 6-inch stroke, designed in all details essentially for fire brigade work, and will supply a reserve of horse power in case same is required. The latest model of automatic carbureter is fixed. The ignition is high tension waterproof Bosch magneto, and also high tension electric with accumulator and distributer, connected with two sets of sparking plugs with turn-over switch, and to be coupled up in such a way that each separately or both ignitions together can be used; twelve sparking plugs being fitted in all. The clutch is leather lined cone shaped, of large diameter and approved design, with outside adjustment for spring tension and a universal joint contained in the clutch to avoid all strain on the crank shaft, thru any distortion of the frame which may occur. The speed gear box is of special alloy aluminum casing, four speeds forward and reverse, which would enable the machine to attain a speed of 35 miles per hour on the level; gate control with ball bearings thruout; machine also capable of ascending a gradient of 1 in 5 with full load. The pump gear box is also of special alloy aluminum oil-tight casing, gear wheels mounted on hardened shafts and ball bearings. A foot-brake drum of large diameter is fitted on the end of the gear box shaft, and two cast iron slippers, bearing on this drum, are operated by means of a double cam movement. These brakes are capable of holding machine on a gradient of 1 in 5. Arbor and pump shafts are of high tensile steel.

The back brakes are internal expanding and made of two cast iron shoes operating against the inside of large diameter drums on the rear hubs, entirely cased in and dustproof. The parallel pinion type of differential is fitted with six planets and two star wheels. The front axle is modern, ample, and of wrought steel.

BIRMINGHAM, *England, ladder and pumping auto fire truck. This apparatus is equipped with an air pump capable of lifting water from a depth of* 29 *feet in as many seconds.*

Steering is worm and segment irreversible, adjustable with ball connecting joints; all joints are covered with leather casings. Turning radius is as small as possible.

Lubrication is entirely automatic thruout, being pressure feed system on well tested and satisfactory lines.

The frame is of channel steel especially strengthened at the points necessary; the underframe carries engine on three-point suspension.

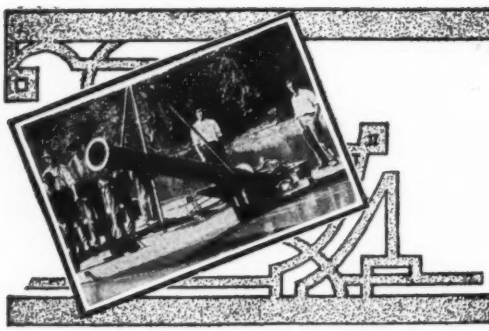
The engine is water-cooled and the wheels are of artillery wood or steel for carrying 34-inch solid rubber tires. The machine will ascend any ordinary gradient on direct drive and will ascend a gradient of 1 in 5 on the lower gears.

The air-pump charging apparatus is very new and in duplicate, there being two double-acting cylinders each working independently, and constructed of a capacity capable of obtaining water from 26 feet or 27 feet in 20 to 25 seconds. The air-pump is brought into action by a lever from the driver's seat, and on the water being obtained, the outlets, if required, automatically open. The whole of the work is done from the driver's seat, and it is not necessary for anyone to go near the pump at all, and no tank of water is required.

The gasoline tank is under the driver's seat and holds 25 gallons.

Three 10-foot lengths of suction hose 5-inch diameter inside of the imbedded wire type are carried, fitted with polished gunmetal screwed unions, with full clearance, copper strainer at end, polished. The body is constructed of the best seasoned wood, and arranged to carry some 1,500 feet of delivery hose, and also fire engine tools in separate locker. The engine seats four men each side facing sideways, and driver and officer in front with brass handrails. Two separate long boxes are arranged at the sides in a convenient position for carrying stand pipes and other gear, the lids forming side steps. Polished brass edging is round, all steps and tops are covered with pyramid pattern aluminum tread. The rear step will accommodate another fireman.

The machines are painted fire engine red and lined white with gold leaf mouldings, the name of the fire brigade being painted in double gold block letters. The usual three lamps are carried.



EDITORIAL

INCREASED EFFICIENCY IN MUNICIPAL SOCIETIES.

In these days of demands for efficiency in municipal operations as well as in private business, the existence of two societies, devoting themselves to the discussion of the same subject, the standardizing of paving specifications, was a duplicate of effort and expense which, after the first year or two of hard work on the part of one of these organizations, did not seem to be justified. The two societies have been discussing amalgamation during the entire life of the newer organization and at the meeting of the American Society of Municipal Improvements at Wilmington, in October, a method of combination satisfactory to both was agreed upon and the consolidation is now an accepted fact.

The A. S. M. I. is now twenty years old but has paid special attention to the standardization of specifications for only five years, while the A. S. P. S. was about four years old. Ex-President Geo. W. Tillson, of the younger society, becomes the chairman of the general committee on standard specifications of the older organization and the members of the committees of the A. S. P. S. become members of the corresponding subcommittees of the A. S. M. I. The latter society returns to a former custom and provides for municipal memberships, a city member being authorized to send as many delegates as it chooses to pay for at $5 a year each and to have as many votes as it has delegates. In this way, the specialized society transfers its activities to the corresponding department of the organization with the larger field and there should be increased efficiency by this concentration of experts.

ELECTRIC LIGHTING ADVANCE.

We seem to be on the verge of another material advance in the field of electric lighting which has already been the field of so many striking

discoveries. The theories set forth in articles and association proceedings seem to be well demonstrated and it only remains to work out the details for successful application to practical use. The new nitrogen lamp will soon be on the market and the new lights on the luminescent principle of the mercury vapor lamp will not be far behind. The articles in this number of Municipal Engineering give the latest information.

GARBAGE DISPOSAL IN CHICAGO.

The garbage controversy in Chicago has become so acute that the city is now dosing its garbage with chemicals and dumping it in abandoned clay pits of brick works in the vicinity and is advising householders to destroy as much of it as possible on the premises so as to reduce the amount of trouble for the city forces as much as possible. To an outsider this seems wholly inexcusable and to be due wholly to the failure of the city council to put the solution of this technical and highly complicated problem in the hands of technical experts with instructions to work it out with reference only to the sanitary and engineering questions involved and with due regard to economy.

Such questions as method of disposal of the garbage and refuse depend so much upon the methods of collection and upon the difference in conditions in various parts of the city and in various business and household districts that no city council or health board can answer them without detailed information and recommendations obtained and made by experts in the field after careful study and measurement of the conditions, quantities and qualities of materials to be handled.

Whether the collection or the disposal or both shall be by contract or under municipal operation are also questions which require the advice of experts before a safe basis for a decision can be laid.

When the decision is made the carrying out of the project must again be put in the hands of experts if satisfactory results are to be obtained

There are enough examples of successful and partially successful plants under both municipal and private ownership now to demonstrate the truth of these statements and to emphasize the follies of which the city council and perhaps other city officials have been guilty.

QUESTION DEPARTMENT

Specifications for Elevated Tanks and Standpipes and for Pipe Laying

In MUNICIPAL ENGINEERING for July, p. 98, you refer to specifications for elevated steel tanks and standpipes by C. W. Birch Nord.

I would like to get a copy of those specifications and also specifications for pipe laying. P., ——— Conn.

The specifications for elevated tanks and standpipes may be found in the Transactions of the American Society of Civil Engineers, vol. xliv, p. 526, and are as follows:

Loads.

1. The dead load shall consist of the weight of structural and ornamental steelwork, platforms, roof construction, piping, etc.

2. The live load considered shall be the contents of tanks, the movable load on platforms and roofs, and the wind pressure.

3. The weight of water shall be assumed to be 63 pounds per cu. ft., and that of crude oil 56 pounds per cu. ft., 1 cu. ft. of fluid being equal to 7.48 gal.

4. The live loads on platforms and roofs shall be taken at 30 pounds per sq. ft., or a 200-lb. concentrated load applied at any point.

5. The wind pressure shall be assumed at 30 lbs. per sq. ft., acting in any direction. The surfaces of cylindrical tanks exposed to the wind shall be calculated at two-thirds of the diameter multiplied by the height.

6. The movable live load on platforms and roofs shall not be consider as acting together with the wind pressure.

Unit Strains.

7. All parts of the structure shall be proportioned so that the sum of the dead and live loads shall not cause the strains to exceed those given in Table 1.

8. For compression members, the permissible unit strain of 16,000 lbs. shall be reduced by the formula:

$$p = 16{,}000 - 70\ l/r$$

where p=permissible working strain in compression, in pounds per square inch;
l=length of member, from center to center of connections, in inches;
r=least radius of gyration of section, in inches;
the ratio l/r shall never exceed 120 for main members and 180 for struts.

9. Stresses due to wind may be neglected if they are less than 25 per cent. of the combined dead and live loads.

10. Unit strains in bracing and other members taking wind stresses may be increased to 20,000 pounds per sq. in., except as shown in Section 9.

TABLE 1.

	Pounds per Square Inch.	
Tension in tank plates	12,000	Net area
Tension in other parts of structure	16,000	Net area
Compression	16,000	Reduced
Shear on rivets and pins	12,000	
Shear on bolts and field rivets	9,000	
Shear in plates	10,000	Gross section
Bearing pressure on rivets and pins	24,000	
Bearing pressure on field rivets	18,000	
Fiber strain in pins	24,000	

11. The pressure given in Table 2 will be permissible on foundations and bearing plates.

TABLE 2.

	Tons per Sq. Ft.
Soft clay	1
Ordinary clay	2
Dry sand and dry clay	3
Hard clay	4
Gravel and coarse sand	6

	Lbs. per Sq. In.
Brickwork with cement mortar	200
Portland cement concrete	350
First-class sandstone	400
First-class limestone	500
First-class granite	600

Details of Construction.

12. The plates forming the sides of cylindrical tanks shall be of different diameters, and shall be calked from the inside. No foreign material shall be allowed when calking.

In oil-tank work, both the inside and outside of the tank shall be beveled for calking.

13. Joints for horizontal seams and for radial seams in the spherical bottoms of tanks shall preferably be lap joints.

14. For vertical seams lap joints shall be used for ¼, 5/16, and ⅜-inch plates; double butt joints for 7/16, ½, 9/16, ¾, and 13/16-inch plates; and triple butt joints for ⅞, 15/16, and 1-inch plates.

15. Rivets, ⅝ inch in diameter, shall be used for ¼ and 5/16-inch plates; rivets, ¾ inch in diameter for ⅜ to ⅝-inch plates, inclusive; and rivets, ⅞ inch in diameter, for 11/16 to 1-inch plates, inclusive.

16. Plates more than ⅝ inch thick shall be sub-punched and reamed.

17. The minimum thickness of the plates for the cylindrical part shall be ¼ inch. The thickness of the plates in spherical bottoms shall never be less than that of the lower ring in the cylindrical part of the tank.

18. The facilities at the plant where the material is to be fabricated will be investigated before the material is ordered.

19. All plates shall be punched before being bevel-sheared for caulking.

20. Radial sections of sperical bottoms shall be made in duplicates of the number of columns supporting the tank, and shall be reinforced at the lower parts, where holes are made for piping.

21. When the center of the spherical bottom is above the point of connection with the cylindrical part of the tank, there shall be provided a girder at said point of connection to take the horizontal thrust. The horizontal girder may be made in connection with the balcony. This also applies where the tank is supported by inclined columns.

22. The balcony around the tanks shall be 3 ft. wide, with a ¼-in. floorplate, and shall have a suitable railing, 3 ft. 6 in. high.

23. The upper parts of spherical bottom plates shall always be connected on the inside of the cylindrical section of the tank.

24. In order to avoid eccentric loading on the tower columns, and local stresses in spherical bottoms, the connections between the columns and the sides of the tank shall be made in such a manner that the center of gravity of the column section intersects the center of connection between the spherical bottom and the sides of the tank. Enough rivets shall be provided above this intersection to transmit the total column load.

25. If the tanks are supported on columns riveted directly to the sides, additional material must be provided in the tank plates riveted directly to the columns to take the shear. The shear may be taken by providing thicker tank plates or by reinforcement plates at the column connections, while bending moments shall be taken by upper and lower flange angles. Connections to columns shall be made in such a manner that the efficiency of the tank plates is not less than that of the vertical seams.

26. For high towers, columns shall have a batter of 1 to 12. The height of the tower is understood to be the distance from the top of the masonry to the connection of the spherical bottom, or the flat bottom, with the cylindrical part of the tank.

27. The bottom plates of stand-pipes shall be not less than 5/16 in. thick, and shall be provided with tapped holes, 1¼ in. in diameter, with screw-plugs spaced at 4-ft. centers to allow a filling of cement on top of the masonry, while the bottom part is being erected, in order to secure the proper bearing.

28. Near the bottom of the stand-pipe there shall be provided one 12 by 18-in. manhole of elliptical shape.

29. Near the top of each tank and stand-pipe there shall be provided one Z-bar acting as a support for the painters' trolley and for the stiffening of the tank. The section modulus of the same shall be not less than $D^2/250$, where D is equal to the diameter of the tank, in feet. If the upper part of the tank is held by the roof construction, this may be reduced.

30. On large tanks, circular stiffening angles shall be provided in order to prevent the tank plates from buckling during windstorms. The distance between the angles shall be located by the following formula:

$$d = \sqrt{t}\ 900/D$$

where, d = approximate distance between angles, in feet;
t = thickness of tank plates, in inches.
D = diameter of tank, in feet.

31. The top of the tank will generally be covered with a conical roof of thin plates; and the pitch shall be 1 to 6. For tanks up to 22 ft. in diameter, the roof plates will be assumed to be self-supporting. If the diameter of the tank exceeds 22 ft., angle rafters shall be used to support the roof plates.

Plates of the following thicknesses will be assumed as self-supporting for various diameters:

3/32-in. plate, up to a diameter of 18 ft. 0 in.

⅛-in. plate, up to a diameter of 20 ft. 0 in.

3/16-in. plate, up to a diameter of 22 ft. 0 in.

Rivets in the roof plates shall be from ¼ to 5/16 in. in diameter, and shall be driven cold. These rivets need not be headed with a button set.

32. A trap-door, 2 ft. square, shall be provided in the roof plate. Near the top of the higher tanks, a platform with a railing shall be provided, for the safety of the men operating the trap-door.

33. An ornamental finial shall be provided at the top of the roof.

34. A ladder, 1 ft. 3 in. wide, shall be provided from a point about 8 ft. above the foundation to the top of the tank, and also one on the inside of the tank. Each ladder shall be made of two 2½ by ⅜-in. bars with ¾-in. rungs. On large, high tanks, 30 ft. or more in diameter, a walk shall be provided from the column nearest the ladder to the expansion joint on the inlet pipe.

35. In designing tanks, 6 in. additional height shall be allowed for over-run.

36. The bracing in the towers shall be adjustable.

37. The size of the anchor-bolts shall be determined by the uplift when the tank or stand-pipe is empty. The unit strains in the anchor-bolts shall not exceed 15,000 lb. per sq. in., and the minimum section shall be limited to a diameter of 1¼ in.

38. The concrete shall be assumed to have a weight of 140 lb. per cu. ft., and shall be sufficient in quantity to take the uplift.

39. Any parts of the tank, stand-pipe, or tower, in which difficulties may arise in field riveting, shall be assembled in the shop, and marked properly before shipment.

40. The structural material shall conform to the "General Specifications for Steel Railroad Bridges" by the American Railway Engineering and Maintenance of Way Association.

41. The workmanship shall be in accordance with the Manufacturers' Standard Specifications of February 6th, 1903.

42. Before leaving the shop all work shall be painted with one coat of approved paint, excepting the laps in contact on the tankwork. All parts which will be inaccessible after erection shall be well painted. After erection, the structure shall be covered with one coat of the same paint.

43. Three-ply frost-proof casing shall be provided, if necessary, around the inlet pipe. This casing shall be composed of two layers of 1 by 2½-in. lumber, and each layer shall be covered with tar paper, and one outside layer of ⅞ by 2½-in. dressed and matched flooring. The lumber shall be in lengths of about 12 ft. A 1-in. air space shall be provided between the layers of lumber, and wooden rings or separators shall be nailed to them every 3 ft. The frost casing may be made square or cylindrical.

Development of Water Supply from Limestone

In the July number of MUNICIPAL ENGINEERING, I read the article beginning on page 36, entitled "Yield of Limestone and Sandstone Wells," and was very much interested; and as I have a proposition in limestone, I am taking the liberty of writing you in the hope that you may find time to give me suggestions in the matter.

The proposition is a small lake or pond in limestone, with diameter of about 200 feet and an average depth of about 85 feet. Near one side there is an aperture or hole in the bottom, about 3 feet across, which has been sounded to a depth of over 500 feet without touching bottom; and the lake flows a never failing, or increasing stream which measures 120 miners inches.

Now the point I wish to find out is this, if I should install pumps with sufficient capacity to lower the lake, say 100 feet, and keep the water and pump at this level, how much could I expect the flow to increase? Should it not increase many times? Such, to me, would seem to be the results which should follow, for the reason that it would mean an increase in the head.

I might also mention that this lake is situated on the slope of one of the biggest mountain ranges in Arizona.

Any information or suggestions which you can give me will be greatly appreciated.

B., Prescott, Ariz.

This subject is quite fully treated in Turneaure and Russell's "Public Water Supplies" ($5) and the principles to be followed in estimating the probable flow of wells for various reductions of head are stated and formulae are derived. In general it may be said that the increase in yield is proportional to the increase in head or the increase in depth to which the water is drawn down. In one instance of a deep well a lowering by pumping of the water level 120 feet below the level at which it stood in the well gave a yield of 10.2 cubic feet a minute and a lowering of the level 238 feet produced a yield of 18.8 cubic feet a minute.

If the yield had been exactly proportional it would have been 20.3 cubic feet instead of 18.8.

The case in question seems to be one of overflow from a water-bearing stratum thru a fissure in an impervious stratum above it, or an outcrop of a fissure in the pervious limestone.

Observation of the variations in flow should show whether they have any relation to the local rainfall or whether they depend upon the supply of water from mountains or highlands at greater or less distances. The aid of a geologist familiar with the country would be almost essential in making this study.

Tests of the flow under pumping would give some information and the longer the tests continue the more information will be available if expert observers are employed. It is possible that the pond is not the only point of overflow of the water in the stratum. In that case keeping the water below the point of overflow in the pond would soon develop the fact by showing an increase in yield greater than the increase in depth to which the water is drawn down.

The overflow of water from the pond being continuous, it is evident that there is a source of supply which is reasonably continuous. If the fluctuations in amount of flow are great, the indications are that the reservoir is not of great area. If they are slight it is probable that the reservoir is large in proportion to the amount of water reaching it.

In case the reservoir is small, pumping will soon show tendency to exhaustion of the supply and the yield will decrease at the point the pump is located or the pump must be progressively lowered to follows the lowering water level. If the reservoir is large this process will be slower and, if the supply of water to the reservoir is intermittent, the yield will be somewhat variable, but if the constant amount of water drawn from the well is not greater than the average supply to the reservoir, the water level will not be permanently reduced by pumping, tho it may vary at different seasons.

If it is important not to overestimate the possibilities of the supply, the development should take place slowly until the balance between supply and pumpage is found.

It will, of course, be possible to increase the supply from the pond or well to any desired extent by pumping down, the increase in yield being, as stated, roughly proportional to the increase in head, but if the pumpage is materially greater than the supply, this development will not be permanent, for the reservoir will be exhausted and then the quantity available for pumping will be subject to the irregularities of the supply from the distant sources.

Unless the development is required for temporary purposes, therefore, the pumpage should not exceed the average supply in order to be permanent.

Expert assistance in making these tests and the development will be worth all it costs.

How to Lay Out a Small City Park

Will you kindly recommend to me a work on laying out small city parks, 20 to 30 acres? I am on a city civic committee and would like to get the latest information.

B., ———, Tex.

The following books will be of special interest, most of them being new books issued since the present development of interest in city planning and the beautifying of cities:

Nolen's edition of Repton's "Art of Landscape Gardening" ($3.22) is a modern setting of a classic in this field.

Waugh's revision of Kemp's "Landscape Gardening" ($1.50) is a similar modernizing of a standard work.

and Cities" ($3) is devoted mainly to

Solataroff's "Shade Trees in Towns street trees, but will be of interest in a study of civic beauty.

Maynard's "Landscape Gardening as Applied to Home Decoration" ($1.50), Parsons' "Landscape Gardening Studies" ($2) and Waugh's "The Landscape Beautiful" ($2) are of more direct application to the development of small areas.

Unwin's "Town Planning in Practice" ($6) is a comprehensive book by an English expert.

Hawkes's "Hints on the Art of Landscape Gardening" is a little book which compels attention and tells where mistakes are made as well as pointing out ways to success.

Mero's "American Playgrounds" ($1.70) treats a subject which should not be forgotten in developing any city park, large or small.

Several civic beauty experts have made reports upon plans for various cities which contain much of direct bearing on a particular case, showing as they do what the existing conditions are and indicating methods of improvement.

Charles Mulford Robinson has put his ideas into two books, "Modern Civic Art" and "The Improvement of Towns and Cities" ($1.25) which treat the subject from all points of view. He has published several reports on improvement of cities, among which the following are at hand: Los Angeles, Cal., Ridgewood, N. J., Oakland, Cal., San Jose, Cal., Denver, Colo., Binghamton, N. Y., Ft. Wayne, Ind., Honolulu, H. I. There are many more. Mr. Robinson was also a member of commissions which prepared plans for Columbus, O., Rochester, N. Y., etc.

John Nolen has put four of his reports

into one book which contains many suggestions applicable under almost any conditions. He also has published a number of separate reports of which that on San Diego is specially comprehensive and beautiful; that on Roanoke, Va., is suggestive for a small city.

Kelsey and Guild made a report on Columbia, S. C.; Carrere and Hastings on Hartford, Conn.; commissions of which D. H. Burnham was an active member, on Washington, Cleveland, Chicago and San Francisco; Olmsted Brothers on Baltimore, Md.; and there are many more of more or less value and interest.

Rates for Fire Hydrants in Gravity Water Supplies

I desire information concerning charges of private water companies to cities for fire plugs per annum and also if 4-inch mains are sufficient fire protection to municipalities. I learn that several water companies charge from $15 to $25 per annum for each fire plug when water is furnished by gravitation entirely. H., ———, Md.

Nearly all the hydrant rentals paid by cities and towns having gravity supplies furnished by companies in the states about Maryland lie between the limits of $15 and $25 a year.

In a list of 75 waterworks in those states, having gravity suplies, nearly all for small cities, towns or boroughs, four pay nothing for fire protection. Many pay a total sum for fire protection and the average per hydrant changes as the number of hydrants changes. Others pay an annual rental per hydrant. Reduced to charge per hydrant per year, which is fairly correct, four towns pay $5 or less, 4 pay $6 to $10, 16 pay $11 to $15, 16 pay $16 to $20, 13 pay $21 to $25, 9 pay $26 to $30, 5 pay $31 to $35 and 6 pay more than $35. There is a little doubling up, for a few cities pay a higher rate for the first few hydrants put in and a lower rate for additional hydrants, and they are counted above for each rate.

Provision for fire protection ordinarily costs less in a gravity system than in a pumping system, but it still costs something, and the amount that it costs can be quite readily determined. This is the only method of determining the amount of hydrant rental which will be fair to company, town, and water consumers, the former of whom is entitled to a fair return on its capital, industry and ability, and the latter are entitled to as reasonable rates as will insure the same. As between the town and the consumer it is evidently not fair that the town should pay nothing for its fire protection, thus leaving the consumers to pay this, in proportion roughly to the water they use, rather than to the value of the property protected. Because one town pays a hydrant rental of $20 is no really good reason why another town under different conditions should pay the same, especially since the real value of the hydrant rental is usually obtained easily, and in view of the modern tendency to fix the charges for water, including hydrant rentals, on the basis of cost and a fair profit, rather than on "what the traffic will bear."

Four-inch pipes are not large enough for reasonable fire protection. But one good fire stream can be taken from a hydrant on a 4-inch main, which would be sufficient for a small fire in a thinly populated residence district and unsatisfactory for anything else. No main intended for fire protection beyond that just stated should be less than 6 inches, and such mains should be in closed circuits with frequent cross lines, so as to bring supplies to hydrants from two or more directions.

In the list of waterworks referred to above the following are in cities of more than 10,00 population: Dubois, Greensburg, Hazleton, Mahanoy City, Scranton, Shamokin, Shenandoah, Pa., and Hagerstown, Md.

Form of Pavement Surface at Street Intersection

Can you tell me where I can find a method of giving the proper shape to the pavement in the immediate vicinity of its intersection with another?

In other words, what form does the proper "contour map" at the pavement intersection assume that seems to be giving the best satisfaction?

If it isn't too much trouble, I would like to know something regarding the practice of different cities in treating this problem, especially when the streets are of unequal widths and intersect at angles other than right angles.

P., City Engineer, ———, Mo.

Theoretically, the cross-section of each street should continue thru the intersection of the two streets as nearly without change as possible, that vehicles can travel as smoothly as possible; the surface of the street should be as nearly level as possible from curb to curb and at the same elevation as the curb in the area traveled by pedestrians, that they may travel across the street with the same smoothness and absence of obstruction that they travel along the sidewalk; and the water should be drained from the area so completely that it will not stand on any part of the intersection. It is evidently impossible to secure all these results in perfection at the same time. The result is compromise, which is further modified by the rates of grade on the streets, the differences of elevation of the opposite sides of the street, the presence or absence of sewers or underground street drains, the amount of storm water probable at the intersec-

tion, the expediency of culverts across the street, etc., so that no two cities have exactly the same general plans and cannot always apply their standard plan to a particular intersection.

In one city custom has fixed the necessity of having no step at the curb for pedestrians and the cross section of the street must be changed so that the street surface is brought up to or near the curb level across the sidewalk of the intersecting street, while in another city the pedestrians are so accustomed to stepping off the curb that any step not higher than an ordinary stair is passed without notice. In the former city a suit for damages might result if a step at the curb caused a fall and in the latter city one might result if the abrupt change in the cross section of the street and the construction of a bridged culvert across the sidewalk caused a fall by an inadvertent step into the end of the culvert or off the end of the bridge. Many of these points are matters of custom and cannot be changed easily.

Flattening the whole intersection for the benefit of the street and sidewalk traffic offers difficulties in drainage which cannot be overcome, so that a third complication is presented.

Assuming a level intersection, familiarity of pedestrians with steps at the curb, and sewers to take the drainage, the simplest case results, for then it is only necessary to ease off the curves of the crowns of the two streets where they intersect, which can be done best by the eye in smoothing off the cushion for a block pavement or the wearing surface for a street pavement. This is ideal for street traffic and drainage, if the sewer inlets are put at the curb intersections, but does nothing for the pedestrian who must step over the water when it is running in the gutter and in any event must step down and up at the curbs and follow the crown up and down in crossing the street between. This can be improved sometimes by flattening the crown slightly where the pedestrians travel and putting in a bridge across the gutter with a slight slope down from the curb, thus keeping the pedestrian out of the water and inserting a very slight obstruction to street traffic by forcing wheels away from the curb at these bridges. Or sewer inlets can be put opposite the end of each property line so that the water will not run across the pedestrian's path, and no other change will be necessary except to deepen the gutter at the inlet and possibly elevate it slightly across the sidewalk so that the water coming down the street will be sure to stop and run into the inlet. In such case care must be taken to give water falling on the street intersection a chance to get to the inlets or special inlets for this water must be provided.

If there is no underground street drainage, a serious complication is introduced. Some cities frankly carry the gutters across the intersecting streets whenever necessary, and every vehicle must slow up to make its bow in running across this gutter, even if the side slopes are made as flat as the necessities of the pedestrians traveling alongside and parallel with it will permit. Others cover these gutters in more or less permanent fashion. This is a difficult matter if the streets are nearly level, but is not so serious if there is considerable slope across an intersection, for then the upper end, at least, of the culvert across the street can be set deep enough to make ample provision for a permanent form of culvert construction.

If the interests of the pedestrians are paramount, the troubles of the engineer increase and the expedients resorted to are almost as numerous as the varieties of form, size, slope and angle of the intersections.

The general rule is to work out as satisfactory a plan as possible, fix and set the curb corners, the center of the intersection and the centers of the streets on the center line of each sidewalk line crossing them, and the location and elevation of each sewer inlet, and then work in the surface of concrete foundation and of wearing layer by eye to make the smoothest and best looking connection of these various points and lines possible in the particular case.

The discussions of the subject in books are not extended. Spalding gives two small pages to street intersections in his "Text-Book on Roads and Pavements," ($2). The rules given by Morrison on one page of his "Highway Engineering" ($2.50) are so seldom applicable as a whole that they serve only as a general indication of the mode of procedure.

Baker gives descriptions and drawings showing methods of making crossings for pedestrians with and without bridges across the gutters, in his "Roads and Pavements" ($5). He calls attention to the resulting difficulties in draining the intersection of the street surfaces, but offers no direct solution. He devotes a half dozen pages to suggestions of methods of solving difficult problems in street intersections where there are considerable differences in elevations and slopes within and adjoining the area of the intersection. Byrne gives some of these suggestions in different form in a couple of pages of his "Highway Construction" ($5).

Blanchard and Drowne's new book on "Highway Engineering ($4.50) devotes about 8 pages to the design of street intersections giving mainly the methods

of design used in New York City. Small cities need not be quite so elaborate in their treatment of the subject. The latest edition of Tillson's "Street Pavements and Paving Materials" ($4) gives the New York method in even more detail in the eleven pages devoted to this subject.

Cost of Various Kinds of Pavement

I would appreciate a comparative estimate of the cost of different kinds of paving material per square yard, including cost of labor in paving. H., Mayor, ———, Tex.

The cost of paving in any particular place depends upon the cost of materials delivered at that place, the wages paid all classes of labor used, the customs followed in letting contracts and doing the work, the methods of paying for the work, whether in cash or orders or bonds general or special, or whether in payments or all at one payment, the discounts on the paper used, etc., and no two cities are exactly alike in all these respects. In making comparisons of the relative cost of two pavements these conditions must also be taken into account and a pavement which is cheapest in one locality may be the most expensive in another. Notwithstanding the great ranges in cost of pavements it is interesting to see how nearly the averages remain the same. It must be remembered, however, that the averages may not be directly applicable in any particular place, and that, for definite reasons the cost at that place may be very different from the average. With this warning the following figures are given as a basis for comparison of the cost of pavements in Texas and states in its neighborhood:

Asphalt pavements cost from $1.90 to $2.50 in the south, with occasional lower prices near sources of asphalt materials and higher prices where freight charges are high. Generally the prices range under ordinary conditions between $1.75 and $2.50, with a few cities under special conditions paying as low as $1.20 to $1.40 and a few where paving materials are high in price running above $3. The median price is about $2.25.

Asphalt block pavements cost from $1.73 per square yard in Savannah, Ga., and $2.10 in Waycross, Ga., to $3.20 in Niagara Falls, N. Y.

Bitulithic pavement costs $2.09 in Ft. Worth and Waco, Tex., and from $1.65 to $2.36 in other southern states. The median price is about $2.10 a square yard.

Brick pavement costs $2.06 in Ft. Worth; $2.20, not including grading, in Houston; $2.25 in Tyler, Tex., and from $1.55 to $2.75 in other southern states, with one pavement on sand foundation at 82 cents. The median price is about $1.75 per square yard.

Concrete pavement costs $1.85 for vitrolithic and $2.06 for Blome pavement in Ft. Worth; $1.85 in Greenville; $1.85 in Hillsboro; $1.40 with bituminous top in Waco; $1.35 for plain 2-course concrete in Wichita Falls, Tex. It ranges from 87 cents to $2.95 in other southern states, the lower prices being usually for forms not patented. Where grading is not included and on country road construction the cost is in some places as low as 75 cents, and Ft. Smith, Ark., which seems to be able to lay all its pavements at record-breaking prices, reports 64 to 75 cents as the cost of 6-inch 1-course concrete pavements. Some of these concrete pavements have a bituminous top and some have steel reinforcement. The median price is about $1.25 a square yard.

Stone block pavements cost $3.95 in New Orleans, La.; $1.75 in LaGrange, and $1.71 in Savannah, Ga. Prices in other cities range from $1.50 to $5.00, much of the variation being due to the differences in distance of the cities from their sources of supply. The median price is about $3.00 per square yard.

Wood block pavements cost $2.70 in Brownsville, Tex.; $2.24 in Shreveport, and $3.00 in New Orleans, La.; $2.40 in Little Rock, Ark.; $2.18 in Albany, and $2.72 in Charleston, S. C.; $2.42 in Greenwood, Miss. The median price is about $2.75 per square yard.

Bituminous macadam surfaces on brokenstone or gravel bases cost about $1.00 to $1.20 a square yard. Bituminous concrete pavements on the same basis cost about $1.40 a square yard.

Incinerating Plants Producing Power

As president of the board of health, I am collecting data for an incinerating plant with an idea of using the by-products and the power energy for electric lighting purposes. Will you kindly advise me who to write to and if you know of any plants now being operated successfully?

Mayor, ———, N. J.

No city in the United States has yet made a successful application of the power developed from an incinerating plant for commercial purposes. Several, like the plant in the Borough of Richmond, New York City, that at Milwaukee, Wis., and that at Westmount, Can., have developed the power necessary to operate the plant. The plant at Milwaukee is reported to have an excess of power and a committee on municipal efficiency has recommended that the necessary machinery be installed for the utilization of this waste power in the generation of electric current. The installation has not yet been made.

There are numerous plants in England utilizing the heat generated in incinerating plants for producing electric current, list of which can be supplied if desired.

Machinery for Oiling Streets

I would like catalogs and information on crude oil spreaders or sprinklers to oil dusty streets; also cost and cheapest way to oil in small towns and cost of suitable oil for such work. J., Idabel, Okla.

The simplest dust-laying treatment of a street or road is sprinkling with crude oil. For this purpose an ordinary sprinkling cart or wagon is used and the oil is applied cold. Better results are obtained with some petroleum residuums and with asphaltic or semi-asphaltic oil emulsions, which can also be applied cold and with an ordinary sprinkling cart if liquid enough. But, the more permanent and valuable petroleum products of the sort require heating and possibly air pressure and special forms of sprinkler apparatus to get them on the road in proper shape and spread them uniformly.

If crude oil or oil residuums are used the asphaltic oils should be used as they have a binding quality which the paraffine oils lack. The latter, therefore, serve only a temporary purpose as dust layers while the former are much more permanent and the frequency of sprinkling is therefore greatly reduced.

The cost depends upon so many strictly local conditions that no definite estimate can be made for a particular case without knowledge of those conditions. Thus a proper oil in Oklahoma may cost say 3 or 4 cents delivered when it might cost 8 or 9 cents or even more on the cars at a point much more distant from sources of supply. Prices of oil are generally increasing each year. The quality of the oil fixes to some extent the amount to be used, and it is better to make several applications of small amounts than one application of a large amount, altho the cost of the several trips over the road with the sprinkler at different times will evidently be greater than that of a single trip distributing the whole amount to be used.

The character of the road surface also affects the amount of oil to be used. Thus a light treatment of a good macadam road may require one-third of a gallon of oil per square yard or less, while a fuller treatment of an earth road may require a gallon and a half or even more per square yard. A macadam surface can be treated with reasonable satisfaction using say a half gallon of oil per square yard if it is evenly distributed and the surface is sprinkled with sand or dust afterward as much as may be necessary to take up any excess of oil which may result from inequalities in the oil distribution.

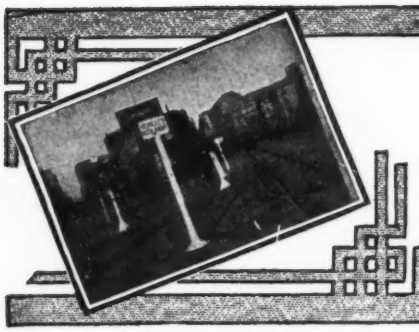
The oil treatment is reported to cost in Washington parks from 1.2 cents per square yard when one-twelfth gallon was used per square yard to 4.6 cents when six-tenths gallon was used. The cost of labor per square yard was 0.8 cent and the cost of oil was 6.5 cents per gallon. Reports indicate that the average cost of oiling macadam roads lies between these limits.

Sprayers for oil and tar can be obtained from the following manufacturers: Wm. F. Irish, 17 Battery Place, New York City, the Johnston oil and tar sprayer; Austin Western Road Machinery Co., Chicago, Ill.; Studebaker Corporation, South Bend, Ind.; Kindling Machinery Co., Milwaukee, Wis.; E. D. Etnyre & Co., Oregon, Ill.; Port Huron Engine & Thresher Co., Port Huron, Mich. Consult the firms listed each month in the Business Directory of MUNICIPAL ENGINEERING under the headings Calcium Chloride, Chloride of Lime, Dust Laying Compound, Heating Wagons Oil and Tar, Johnson Sprayers, Motor Truck Oilers, Motor Truck Street Sprinklers, Road Binder, Road Machinery, Road Oils, Road Oilers Horse Drawn, Road Scarifiers, Scarifiers, Scrapers, Sprayers, Sprinklers, Street Sprinklers Horse Drawn, Tank Wagons, for machinery and materials of use in such work. All the firms named will send catalogs on request.

Cement Sampler

We would thank you if you would tell us who manufacture cement samplers for obtaining samples from the center of a barrel. H., Chicago, Ill.

Grain or flour samples should be suitable for the purpose. In Chicago they can be obtained of H. W. Caldwell & Son Co., 17th and Western Ave., and Moore & Lorenz Co., 814 Fulton St. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.; Tinus Olsen & Co., 500 N. 12th St., Philadelphia, Pa., and Riehle Bros. Testing Machine Co., 1424 N. 9th St., Philadelphia, Pa., can supply them.



WORKERS IN THE FIELD

Smoke Abatement Ordinances

The Editor of MUNICIPAL ENGINEERING:

Sir—In popular discussions of the smoke problem attention is frequently called to the "enormous losses" resulting from the failure to burn the solid carbon particles that pass out of the stack in smoke. If this were the only, or even the greatest, loss attributable to smoke emission, the need of the smoke abatement would concern only those using a given fuel and might be overlooked, inasmuch as the heating value of the carbon escaping as solid particles represents only 1 to 3 per cent. of the total heat units in the coal used. There are, however, other and greater losses from the partial burning of carbon to carbon monoxide (CO) and from the escape of unburned hydrogen and hydrocarbons. Under some conditions of furnace design the latter losses may amount to 20 per cent. of the heating value of coal.

When furnaces are operating under smoke-producing condition, not only is fuel wasted but the damage resulting from the effects of the smoke is enormous and affects the public directly. It has been estimated that in Cleveland, Ohio, this damage amounts to $12 per capita per annum. In Chicago the damage has been estimated to equal four-fifths of all the taxes levied for municipal purposes, or a sum equivalent to at least 80 per cent. of the cost of all the coal burned. Among the many ways in which this damage makes itself felt are: By increased expenditures for repairing and repainting exteriors and interiors of buildings, for artificial light made necessary by the decreased amount of sunlight, for laundering and cleaning, and by injury to vegetation.

The Bureau of Mines recently sent out inquiries to the officials of the principal cities of the United States soliciting information concerning the smoke conditions in the various municipalities. In studying the data thus obtained the cities were divided, according to population, into the three following classes: First, cities having less than 50,000 inhabitants; second, cities with 50,000 to 200,000 inhabitants, and, third, cities of over 200,000 inhabitants.

The data showed that out of approximately 240 cities in the first group 12 reported having either a smoke ordinance or an official charged with smoke inspection. From the second group, about 60 replies were received and of the cities represented by them, 17 are making more or less vigorous efforts to suppress the nuisance. Of the 17 cities mentioned, the most attractive are Des Moines, Ia.; Lowell, Mass.; Syracuse, N. Y.; Toledo, Ohio; Richmond, Va., and Atlanta, Ga. Of the 28 cities having over 200,000 population, 5 are making practically no effort toward smoke abatement, but in three of these fuel oil is used almost exclusively, and the smoke problem is not serious.

Among these cities, three of them, Denver, Detroit and St. Louis, have smoke ordinances merely to prohibit the emission of smoke within certain limits, but provide a clause designed to protect the rights of the infringer of the ordinance. Buffalo has a similar ordinance, but of such a drastic nature that its effectiveness is largely vitiated. Newark, likewise, has a prohibiting ordinance with a clause giving immunity for a certain time, thus permitting changes in plants where required. New York prohibits smoke emission and prescribes penalties, but does not supervise the design of new plants.

The smoke department of the city of Chicago is holding every new plant in the city to a standard of 2 per cent. smoke density on 10 hours observation before issuing a certificate of operation, as provided for in the ordinance. That this standard is not unreasonable, even in the hand-fired installations, may be realized when it is stated that with approximately 250 new plants which have been installed under permit since January 1, 1912, practically all of them that have been put in operation are able to show this low density on a Ringlemann chart. Those which do not show this density are studied with a view to improving conditions, and no certificate of

operation is issued until this standard is reached. For the purpose of keeping track of this work, a form of certificates of operation release has been prepared. This certificate, after giving the type of boiler and furnace, provides for a statement by the engineer of the district that he has personally seen the furnaces in operation, carrying their regular working load, and that he knows personally that the plant can be operated inside the ordinance. To this form is attached a Ringlemann chart reading showing a day's observation with 3 per cent. density or less; the certificate is then issued, a copy of the Ringlemann chart going to the plant owner with a statement that this is the standard which the smoke department will expect the plain to maintain in the future. As the Ringlemann chart is taken with the full knowledge of the operators, it really sets a mark for them to maintain, and any deviation from it is quickly noticed by the smoke department and followed up until the plant is clean at all times.

During the past few years we have installed steam blast heating and ventilating systems in hundreds of public school buildings in Michigan, Indiana, Ohio, and other central western states and in the majority of these instances have installed a type of boiler having a double grate construction which permits the infusion of a sufficient supply of heated oxygen into the combustion chamber, which oxygen unites with the fuel, giving combustion of gases which might otherwise escape. The hot gases also have a long travel, as they pass thru the tubes in the boiler, then entirely around the boiler, before making their exit in the breeching. This type is familiarly known as the Kewanee and possesses a very low water line. This type of boiler is working under varying pressure ranging from 5 to 40 pounds, with minimum of smoke exhaustion when properly fired.

J. W. BRYCE,
Bryce Heating and Ventilating Co.,
Toledo, O.

Comparative Street Cleaning Costs

The Editor of MUNICIPAL ENGINEERING:

Sir—During the past year an average of 188 laborers were employed in cleaning the streets of the city. The force was divided into two shifts, a day and a night shift. The night shift consisted on an average of 80 men, and was detailed to clean the hard surface streets in the business district. Of the night shift 74 men operated 12 power brooms, 4 sprinklers and 24 carts and cleaned 742,000 square yards (35 lineal miles) per night at a cost of 27 cents per 100 square yards or $5.81 per mile. The remaining 13 men on the night shift operated 6 flushing machines, and cleaned 169,600 square yards (8 lineal miles) per night at a cost of 21 cents per 1,000 square yards or $4.47 per lineal mile. The total cost of cleaning by night was $73,890 of which $5,000 was for the flushing gang and $68,890 for the other gang.

The day shift consisted of 101 men, detailed as follows: 26 men who operated five power brooms, two sprinklers and ten carts, for cleaning hard surface streets in the outlying districts. They cleaned an average of 275,600 square yards (13 lineal miles) per day, at a cost of 25½ cents per 1,000 square yards, or $5.50 per lineal mile; total cost for the year, $22,000.

Twelve men, who operated six tank flushing machines for cleaning hard surface streets in the residence district, cleaned an average of 212,000 square yards (10 lineal miles) per day, at a cost of 18 cents per 1,000 square yards, or $3.85 per lineal mile; total cost for the year $11,000.

Three men and one horse, who operated one hose flusher for cleaning hard surface streets in outlying districts, cleaned an average of 26,500 square yards (1¼ lineal miles) per day at a cost of 31 cents per 1,000 square yards, or $6.50 per lineal mile; total cost for year $2,500.

Eleven men, each with a patrol cart and one man with a horse and cart were employed at cleaning up horse droppings from hard surface streets in the business section. Each patrol cart kept eleven blocks clean; total cost for year $10,000.

Twenty-three men and fourteen carts cleaned and carted away the dirt from macadam and gravel streets. They cleaned an average of ¾ mile per day at a cost of $77 per mile. Total cost for year $15,250. As there are 140 miles of this class of improvement in the city, it takes the present force 187 days to cover this distance once.

We also operate two Kindling squeegee machines which have been giving excellent service, each machine averaging 74,200 square yards per working day of 8 hours and at a cost of 11 cents per 1,000 square yards. It should be understood that these machines thoroly sprinkle and clean in one operation, removing on the average of 4 cubic yards of filth per 1,000 square yards of pavement cleaned.

T. M. HURLBURT,
City Engineer, Portland, Ore.

Negro Segregation Ordinances

The Editor of MUNICIPAL ENGINEERING:

Sir—As to the legality of negro segregation ordinances, there is a good summary of this matter in the *National Municipal Review* for April, 1912, and from

this article we are led to believe that ordinances passed in Richmond and Ashland, Va., may have stood the test.

A report on this matter was recently made in St. Louis by the Civic League, which is unfavorable to any such segregation, and endeavors to show that it would always be unconstitutional.

ANDREW LINN BOSTWICK,
Municipal Reference Librarian,
St. Louis, Mo.

Following is an abstract of the proposed ordinance and of the report upon it referred to by Mr. Bostwick:

The proposed ordinance provides in its first section that no white person shall move into a block, a majority of which is occupied by negroes; in its second section that no colored person shall move into a "white" block; and in its third section excepting domestic servants residing in the houses in which they are employed.

The report states that a similar ordinance in force in Baltimore is under test in the courts and an adverse decision is expected. The arrests under the ordinance have been of 28 whites and 6 negroes and the enforcement of the ordinance is expected to die out if the ordinance is not killed by the courts. Two earlier ordinances were declared unconstitutional. Richmond, Norfolk, and Ashland, Va., Winston-Salem, N. C., and Greenville, S. C., have ordinances excluding colored people from certain streets or blocks. Atlanta has a voluntary agreement.

There is little trouble in northern cities, altho sentiment and clannish feeling tend to restrict the colored population to certain rather loosely defined districts or to the alleys, and there is little trouble in southern cities so long as colored people keep to the alleys and their own streets. The troubles arise in what the report styles border cities where the conditions and sentiments are mixed. When the general sentiment and opinion of the community is strongly in one direction that line is followed and, except in cases of very flagrant injustice, no difficulties arise.

Cost of Re-Cut Granite Block Pavement

The Editor of MUNICIPAL ENGINEERING:

Sir—Following is a statement of the cost of re-cutting 12 by 4 by 8-inch old granite blocks to 6 by 4 by 4-inch new blocks, dressing and laying them into 4 inches of moist 1-3-6 portland cement concrete, with 1-2 portland cement grout joints and surface plaster:

200 Square Yards Area.	Unit Cost.	Total Cost.	Cost per Sq. Yd.
204 hours cutting and dressing	$0.625	$127.50	$0.63750
90 hours paving	.625	56.25	.28125
68 hours assisting foreman	.4375	29.75	.14875
24 hours teaming	.625	18.00	.09000
6 hours teaming	.500	18.00	.09000
323 hours unskilled labor	.28125	90.85	.45425
25 bbls. portland cement	1.24	31.00	.15500
8 loads concrete sand	1.00	8.00	.04000
12 cu. yds. crushed stone	1.75	21.00	.10500
		$382.35	$1.91175

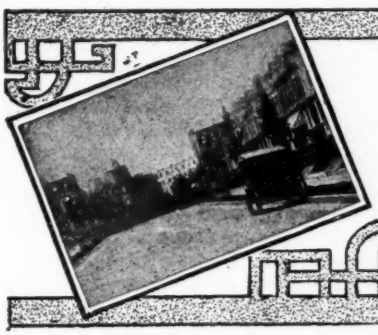
Note that the rates of labor are as follows per day of 8 hours:

Assistant foreman	$3.50
Granite block cutters	5.00
Granite block pavers	5.00
Laborers, unskilled	2.25
Teams, wagon and driver	5.00
Horse, wagon and driver	4.00

The above paving work was laid on Lower State street, at the west approach to the Erie Canal bridge, one-half, or about 100 square yards, at a time, and under trying traffic conditions that made it more expensive than it otherwise would have been.

This work was done by direct city employment.

C. A. MULLEN,
Superintendent of Public Works,
Schenectady, N. Y.



ROADS AND PAVEMENTS

Development and Maintenance of Highways in Allegheny County, Pennsylvania

By John S. Gillespie, Road Commissioner, Pittsburg, before the American Highway Association.

The surface of Allegheny county, Pa., is undulating and near the large streams hilly. The lands are fertile and make excellent farms. The great wealth of the county lies in its immense mineral resources. Bituminous coal of the finest quality abounds, varying in thickness from 5½ to 8½ feet. It is so situated that all its main roads lead to Pittsburg which is in the center. These main roads lead to the outer borders of the county, connecting up with Butler, New Castle, Washington, Freeport, etc., with many cross connections. In fact its features resemble a wheel, Pittsburg being the hub.

Good roads evidently were given careful consideration in years gone by, as shown by data on old turn pikes and toll roads, which were largely planked roads, having a plank roadway 8 feet in width with an earthen or summer road alongside. There are several miles of such roads still in our county, now dedicated to the public.

The road department of Allegheny county was created under the Flinn road act of 1895. This act was effective until May 11, 1911, when a new act was approved providing for the improvement of routes through cities and boroughs, thereby connecting up with the road system in general as laid out by the county commissioners. This new act also increased the bonding power of the county for road improvement, allowing the issuance of two per cent. of the assessed valuation, without being compelled to submit the matter to a referendum, the possible bond issue amounting to $22,000,000.

The present commissioners of Allegheny county are Irvin K. Campbell, J. Denny O'Neil and Stephen J. Toole, now in their second term.

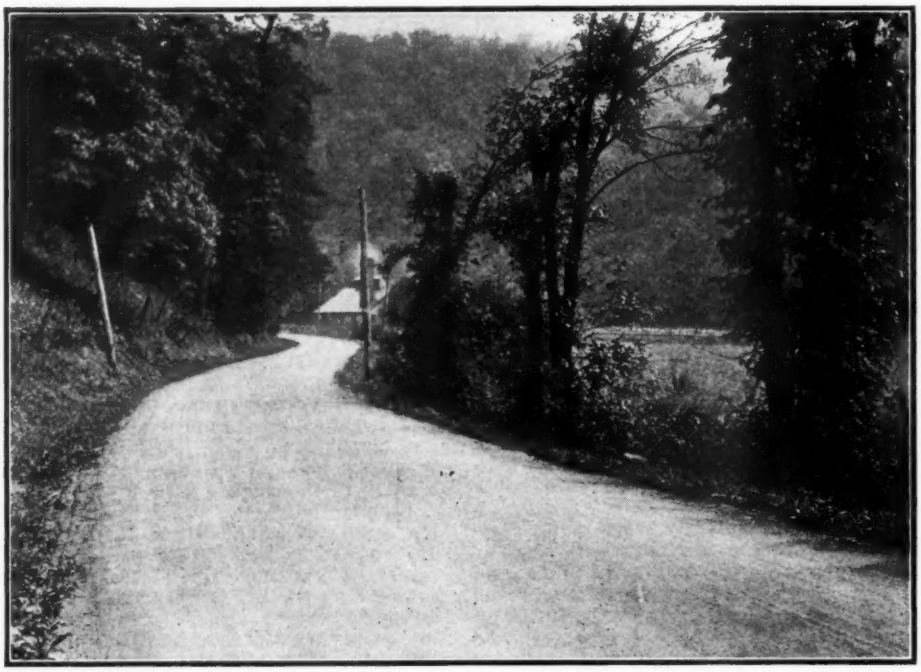
The road department commenced building roads in August 1897. We first started by building roads with telford foundation 8 inches in depth and macadam wearing surface 4 inches thick. Our roads are all graded 30 feet wide, and in the majority of cases, the improved portion is constructed 16 feet in width. In a few cases we only improve 14 feet.

Up to the end of 1905 we had 153.7 miles of macadam road, today we have 437 miles of improved roads of various kinds complete and under construction. Aside from this there are 22 miles of plank road. The two remaining planked roads, however, have been taken over by the highway department of Pennsylvania, being a part of the famous Sproul system. Portions of these planked roads have been improved with brick and asphalt-macadam construction, and it will be but a short time until they are a thing of the past.

Under the acts already mentioned, the county of Allegheny, up to the end of 1912 issued $10,250,000 in road bonds. A road tax varying from 2/10 of a mill (this being the tax levy in 1902) to ¾ of a mill (the present tax levy), has yielded $4,449,040.90, this having been applied to maintenance and sinking fund charges. The sinking fund charges from 1902 to 1912 amount to $3,904,791.10 leaving $10,794,249.80 as a net amount for road purposes.

At the time we commenced building macadam roads, they were considered the "ideal roads." Conditions alter cases, however, and with the advent of the automobile, the heavy truck, and continued use of narrow tires, it was readily seen that a more substantial road would have to be considered. Narrow tires play an important part in the ruination of a macadam road. Our roads we think are constructed right, the best of material obtainable is used for the surface and still the macadam road cuts into ruts. Our board of commissioners at once realized that a more durable road would have to be adopted, so in 1909, after a careful investigation of roads in and thru the eastern states,

they awarded contracts for the first asphaltic concrete surfaces in Allegheny county. The ease with which the surface is laid, the slight inconvenience afforded the traveling public and the fact that it is a dustless road convinced the commissioners and the public in general that it was a step in the right direction. Since constructing the first asphaltic concrete roads, our commissioners have received numerous requests for this class of pavement. The roads first treated were those subjected to the heaviest travel, those to Freeport and Steubenville, subject to automobile travel, hauling heavy



HULTON ROAD, *Allegheny County, Pa., nearly three years old. No maintenance expense as yet.*

building supplies, etc., neither of which has as yet required one penny of cost for maintenance, and both seem to be improving with age.

We feel that we will not be required to do anything in the way of repairs for 8 to 10 years, while the macadam road under our conditions requires resurfacing or top dressing every two or three years at the best. Mud from the side roads is dragged on the roads and remains there until dried out by the sun. The first rain washes the surface of the bituminous road clean. With the hot mixed material no delay is suffered by passing vehicles, the road is at all times open to travel, while the macadam road suffers more or less during the time of resurfacing, until the same has thoroly bonded. The bituminous surface makes an ideal road thru villages and residential sections.

The bitulithic pavement is made of crushed stone, sand and asphalt. The stone is mixed in predetermined proportions as regards sizes, to provide for a maximum density and minimum of voids, so that when rolled in place it is nearly as dense as a block of stone. The surface offers as little resistance to traction as asphalt and it is not slippery. The small stone used provides a gritty surface somewhat similar to macadam and affords a secure footing for horses at all times. The application of the seal coat makes the road practically water-proof. It easily supports the passage of high speed vehicles and heavy travel without loosening the bituminous filler and therefore does not affect the stone and no dust comes from the pavement or its material.

In using the term "asphaltic concrete" I wish to make it clear that I do not refer to the form of construction which has been exploited during the past two years and mis-named asphaltic concrete, being merely a sheet asphalt or mortar pavement (less the essential binder course) with a very little (the specifications say "less than 10 per cent.," which

may be none) crushed screenings coarser than ¼-inch size. The presence of this small percentage of fine crushed stone surrounded or floating in mortar, in my opinion, makes the construction weaker than a pure asphaltic mortar without the screenings, for the reason that the tendency of traffic is to dislodge any of the other detached particles of stone which may be near the surface.

The asphaltic concrete of Allegheny county measures well up to the clear concise definition adopted by the American Society of Municipal Improvements for true asphaltic concrete, as follows: "Bituminous concrete is a pavement consisting of a combination of broken stone and sand or fine mineral matter, cemented together with a bituminous cement and which has all the ingredients mechanically mixed before being laid. To be termed a bituminous concrete it must partake of the well-known characteristics of concrete, that is, there must be stone enough in its composition to form an important part thereof and add to its strength and durability; also, there must be enough of the mortar constituent that it, the sand and bituminous cement, may properly support and bond together the largest particles." This differentiation between true and real and the spurious misnamed asphaltic concrete is most important.

The maintenance of the macadam road is expensive in our county. We do not have any local stone that will answer; it is all shipped in by rail. In the majority of cases we have hauls of 4 to 6 and in some cases 8 and 9 miles from the railroad to the road. This material must be handled a couple of times and you can readily appreciate why our macadam roads cost so much.

While we have paid considerable attention to the asphaltic concrete road, asphalt penetration work also was carried on. Various grades of asphalt were used for this work and the roads laid to date all seem to be in excellent condition. Close on to 45 miles of this class of road have been laid. This pavement has been laid on roads that are not subject to as heavy travel as the ones on which we placed asphaltic concrete.

The brick road has not been overloked either. Approximately 42 miles of brick roads have been laid. Probably half this mileage has been laid with the old macadam road as a base. This work is done by the maintenance branch of the road department. Brick construction costs $22,000 to $25,000 per mile, and covers 13 feet 6 inches of brick pavement, two concrete curbs (flush and combination curb and gutter types) with concrete base 5 inches in depth. It also covers grading, drainage, etc. Our grading averages 11,000 to 12,000 cubic yards per mile of road. Many streams are encountered, and the construction of culverts and bridges further adds to the cost.

The surface of the old macadam road is scarified and formed to a true cross section, concrete curbs are built, sand cushion is placed and the bricks are laid. The surface is then grouted with a cement and sand mixture of equal parts. The old macadam base gives us a road much cheaper than with the concrete base and we get a solid foundation. One of the bad features is the grinding off of the brick at the expansion joints alongside the curb and the breaking off and grinding up of the concrete curb.

DAIRY FARM *Road, Allegheny Co., Pa. Third summer, with no maintenance expense.*

Most of the asphaltic concrete roads have been laid over the old macadam after levelling up and scarifying where the contour or depressions are such as to require much regulation of grade. It is my belief, based on our practical experience of 4 years, that this is the most economical and successful method of conserving the macadam on country thorofares on which the automobile traffic has become so great as to make it impracticable and uneconomical to longer maintain the macadam wearing surface.

Where traffic is light and particularly in the outlying sections, macadam surface is still laid. In this year's recon-

struction work by our maintenance department, we are laying about 8 or 9 miles of water-bound macadam. In order to prolong the life of our macadam roads, we have done considerable in the way of experimenting with light and heavy bodied asphalt oils, using screenings and torpedo gravel in connection therewith. The light oils are mostly used for dust-laying purposes. This is an important part of our season's work, and we keep eight tank wagons applying oil, to relieve the people that reside along the macadam roads. We are just about completing our 1913 oiling, and have used over 250,000 gallons of oil.

It is necessary good asphalt be used in the asphaltic concrete roads. On our Freeport road, reconstructed with this kind of surface in 1910, a huge slip occurred this spring, carrying part of our road away with it. From this part we had samples cut which do not show any wear whatever. The asphalt used in its mixture was the best that could be obtained, and in the sample taken up the asphalt still retained plenty of life.

Allegheny county was not only among the first in the matter of road improvement, but at the same time we inaugurated a patrol system which has been in service since the completion of our first roads, and is added to as occasion demands. Today we have 128 caretakers in our endeavor to place a man on each road, that is, on each 4 or 5 miles of road. It is the duty of these men to keep the roads in good shape at all times, so far as minor repairs are concerned. They are required to look after the drains; the earthen road alongside the improved portion must be kept free from grass and weeds; all loose stones must be removed from the road; and they must look after the removal of small slips or slides; also the matter of obstructions, such as telephone and telegraph poles, sewer heads, bridge walls and copings, etc., the same must be whitened or whitewashed. These act as guides to the traveling public and are very much appreciated. They are also required to make detailed report to the department on any accidents that occur.

This description deals entirely with the county roads of Allegheny. We have several miles of road improved by the highway department of Pennsylvania. No aid was extended to the county in its system of roads, but in order to get additional mileage of improved roads, the county has in numerous cases joined with the state in improving state roads within the limits of the county, paying one-eighth and in some cases one-fourth of the total cost.

Paving Construction, Maintenance and Cleaning in St. Paul, Minn.

By J. H. Beck, General Secretary, St. Paul Association of Commerce.

The streets of St. Paul are being put in better condition this year than ever before, and all of the work thus far has been done by the city itself. At the beginning of July, about 400 men were employed in the paving work, twice the number employed in such work last year. The city of St. Paul has gradually built up its equipment for paving and now has a new asphalt plant, four concrete mixers, ten dump wagons, two road rollers, and a quantity of miscellaneous tools.

Since the city began doing its own paving the citizens have manifested a greater and keener interest in the work, and as a result thousands of men who formerly took everything for granted as to paving materials and methods are now pretty thoroly conversant with the latest pav-

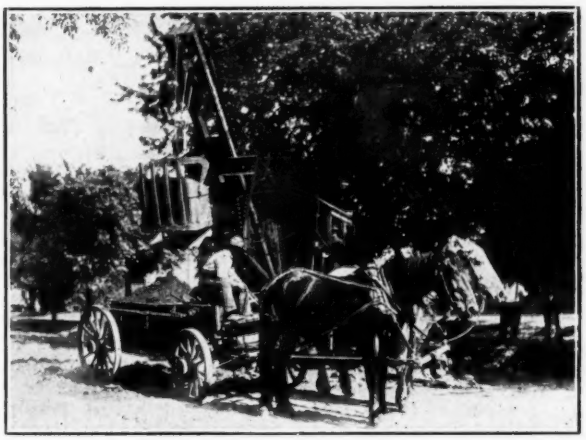
PAVING CONSTRUCTION *in St. Paul, Minn.*
Hauling stone.

ing and its advantages over obsolete methods. It has been clearly demonstrated that many economies are effected without detriment to the work, since the city began laying its own pavements.

The work of paving has progressed very rapidly. Inside of one month the city had all its sub-grade removed from Summit avenue; in a little more than another week all the concrete was set in place, the machine moving to Pleasant avenue between Sixth and Ramsey streets.

Having a larger appropriation under the new amendment to the charter, the superintendent of streets has kept the streets of St. Paul in better repair and cleaner this year than ever before. Since early spring 42 teams and nearly 100 men have been at work grading and dragging the dirt streets, 15 road graders and 25 drags being used. The enormous expense of keeping dirt streets in condition for traffic is apparent when it is considered that the work on all such roads has to be done each spring and again after every heavy rain. Even with the best care which can possibly be bestowed upon them, it is impossible to make them satisfactory to the traveling public.

Not only are the streets being improved by new pavements and repairs, but they are being kept clean. This is especially true in the business center of the city. There the streets are flushed every night, the department having four flushing machines and two sweepers in operation for 16 hours each day, the work being done by two 8-hour crews. In addition the city has one flusher in reserve which gives opportunity for overhauling and repair work without interfering with the service. In a 16-hour day the flushers clean an average of 94½ blocks. Last year, one hose was used in flushing and the cleaners did well if they got ten blocks in a night. The new equipment and system provide greater efficiency and have proven economical.



PAVING CONSTRUCTION *in St. Paul, Minn.*
Excavating with steam shovel.

PAVING CONSTRUCTION *in St. Paul, Minn.*
Grading with twelve-horse team.

PAVING CONSTRUCTION *in St. Paul, Minn.*
The concrete mixer gang laying pavement foundation.

Cost of Hauling With Road Roller

By R. G. Griffith, of B. G. Coon Construction Co., Luzerne, Pa.

Grading and road construction work make peculiar demands upon a road roller; call for a machine which has power reserve, which can travel easily over soft ground and loose earth and up and down all kinds of grades, and which is under perfect and instantaneous control of the operator. We have completed several interesting pieces of road grading and train hauling work during the past year in which we used a Huber combination road roller, furnished by the Huber Mfg. Co., Marion, Ohio.

With this outfit, an average of 1,000 cubic yards of earth per day were taken out, using 11 teams and 1½-yard dump wagons and hauling from 1½ to five blocks, or an average of three blocks. An average of 70 to 80 loads per hour was made, and in some instances as many as 45 loads were taken out in 30 minutes. It is stated that if there had been no time lost waiting for teams, 100 loads could have been taken out in an hour. This work was done under seeming great difficulties as the grades on the pitches of some of the hills were 30 per cent. and the traction surface was of a soapy clay nature.

The following data give a concise record of cost of hauling by means of this combination roller as compared with teams. The average length of haul, on which the following figures are based was three miles:

Number of cu. yds. of stone hauled by roller	2,590
Number of cu. yds. of stone hauled by team	3,980
Number of days outfit was on job	120
Number of days outfit hauled (fraction counted as full)	40

Costs.

Cost of roller operator (salary and expense straight time)	$340.00
Cost of fireman (actual time worked)	66.20
Coal, oil and supplies for outfit	181.81
Cost of maintenance of hauling outfit (one-half season)	53.00
Total	$641.01
Total cost per cu. yd. for hauling	$0.247
Actual cost per cu. yd. for team hauling (on same work and same length haul)	.560
Cost of hauling by roller per cu. yd. per mile	.082
Cost of hauling by teams per cu. yd. per mile	.186

Detailed Cost of Roller Hauling per Cu. Yd. per Mile.

Operator	$0.043
Fireman	.008
Coal, oil, etc	.024
Maintenance	.007
Total	$0.082

That the work of a combination roller need not be confined to rolling, hauling, and stationary plant operation, can best be illustrated by the fact that we also used our machine for pulling small trees without the aid of falls or snatch blocks. One end of the chain was attached to the draw bar of the engine by means of a clevis, and the other end was given one and one-half turns around the tree to be pulled, and the end of the chain made fast with a grab hook. The first trees attempted were about 3 inches in diameter, of persimmon, elm and black jack, all well rooted. Taken one at a time, they pulled out without great difficulty. We next tried the experiment of pulling trees with one hitch by taking two turns of the chain about the first tree and leading the chain back to a second. This proved feasible, and the plan was extended as experience was gained to as many hitches as were permitted by the length of chain available, when the trees were not too large.

For the larger trees, 4 to 8 inches, a single pull to each tree was taken. We quickly learned to make the hitch as high above the ground as practicable, and a block of wood 8 to 10 inches in diameter by 4 feet long was thrown on the ground against the tree and directly under and at right angles to the chain. This bearing acted as a fulcrum when the tree bent over by the pull, and served to bring a very powerful pull on the roots remote from the engine. In case of a few 8-inch black locusts, a man stood by the tree with an axe and struck off the roots remote from the engine as the pull indicated their location. This process aided materially. It was found that the most satisfactory results were secured with the larger trees when the hitch was made at a height of from 3 to 5 feet above the ground.

Exemptions from Peddlers' Licenses in Minnesota

The laws of Minnesota provide that any honorably discharged soldier, sailor or marine who served in the Civil war or the Spanish-American war shall be exempt from the license fees required from peddlers. Various Minnesota cities have been troubled with persons claiming to hold such discharges, and the mayor of Blue Earth, H. J. Frundt, warns others that the discharge of Ross H. Dyar does not exempt him from the fees, and the control of the ordinance, because he did not serve in either war.

SANITATION

Sewage Disposal Plant at Springfield, Mo.

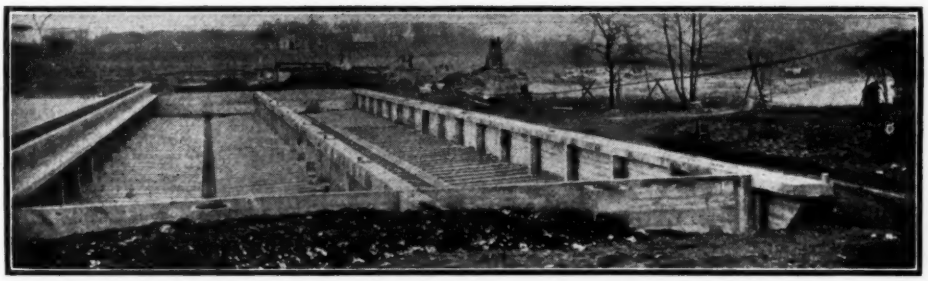
The following description of one of the sewage disposal plants at Springfield, Mo., designed and constructed by Alexander Potter, consulting engineer, New York City, is taken from a paper before the American Society of Municipal Improvements and shows some departures from common practice, particularly in such details as the concrete struts thru the tanks; the provision for inducing a vertical circulation in the upper part of the digesting chamber of each tank; the mechanical distribution of sewage over the filters, being the first installation of such machinery in this country; and the concrete channels in the bottom of the filter bed.

On account of the limited area available it was deemed advisable to use intermittent filters instead of contact beds. The ordinary type of sprinkling filter could not be used, as such a filter requires a head of at least 5 feet to operate the nozzles. Such a head could be obtained only by pumping. Mechanical distribution was therefore recommended. The distributer selected is operated with a head of only 12 inches.

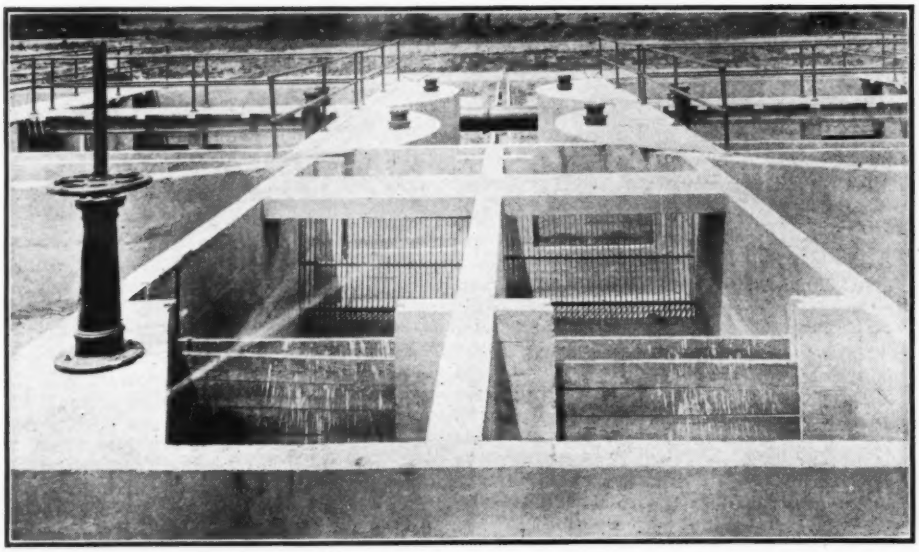
The plant as built consists of a grit chamber built in duplicate, two settling tanks of the two-story type, a sprinkling filter divided into six units, each 53 feet 9 inches wide and 200 feet long, a sludge bed 0.35 acre in extent, and a final settling basin of 150,000 gallons capacity, located at the outlet, 3,600 feet from the remainder of the sewage disposal plant.

The grit chamber is constructed in duplicate. The flow in the grit chamber is retarded sufficiently to retain only the suspended mineral solids which would interfere with the operation of the settling tanks. Provision is made so that during times of flood the back pressure on the outfall sewer can be readily and quickly relieved, thus scouring out whatever deposits may have formed in the 36-inch reinforced concrete pipe.

Concrete, either plain or reinforced, is practically the only structural material available for constructing sewage settling tanks of the dimensions required for a large municipality. So far as the writer knows, the circular tank has been used in this country only in constructing the smaller units; for the larger sizes it has been customary to use rectangular construction. The rectangular form under all conditions, and especially when a large portion of the tank is above the surface of the ground, is a more expensive form to build. The Springfield sewage tanks are neither square nor truly circular. Each unit is four-leaf clover shaped, consisting as it does of four semi-cylindrical segments 26 feet in diameter. This type of construction is peculiarly well fitted not only to resist the



SPRINGFIELD, MO., *Sewage disposal plant; filter bed ready for filling with broken stone.*



SPRINGFIELD, MO., *sewage disposal plant. Completed grit chamber, with settling tanks on either side.*

water pressure from within, but also the earth pressure from without when the tank is below the ground and empty. The shell of the semi-circular segments is 12 inches thick, reinforced vertically with ¾-inch bars spaced 3 feet centers and circumferentially with ¾-inch square bars spaced so that the unit stress does not exceed 14,000 pounds per square inch. The unbalanced tension at the point where the semi-circular segments intersect is taken up by 1¼-inch circular rods embedded in concrete struts.

The steel reinforcement in these ties is designed to resist the tensile forces at the same unit stress as the circumferential reinforcement in the shell. If this is not done, and different stresses are used for the tie rods than are used for the shell, the shell, instead of being subjected to simple tension, will be subjected to bending. The tie rods are fastened to a steel plate 8 inches wide, ⅞-inch thick, bent to a 5-inch radius. By means of double nuts the reinforcement is kept in accurate alinement which insures equal distribution of the tension among the larger number of the tie rods.

The cylindrical segment must be free to expand in all directions. If the expansion is in any way prevented by interior construction, such as the troughs, false bottoms, beams, etc., the shell, instead of being under tension only as contemplated by the designer, will be subjected to heavy bending, often sufficient to cause the fracture of the structure. To permit of the free expansion of the shell when under internal pressure, all interior construction, except at the intersection of the ties and struts with the shell, is separated from the shell by expansion joints.

After passing thru the grit chamber, the sewage enters the distributing trough, which is 2 feet wide, and holds, under normal conditions, about 2 feet of liquid. Eight 8-inch circular openings, placed in the sides of the trough near the bottom and on the side next the outer wall, admit the sewage to the settling compartment. At the end of the trough is an additional opening, placed so as to be but half submerged, so that whatever scum may tend to collect in the distributing troughs is carried over into the settling compartments. Each settling compartment has a capacity of 111,000 gallons, which gives an average period of retention of 1.4 hours when the plant is operated at 4,000,000 gallons, its capacity. The flow in the settling compartment is parallel to the direction of the slot. To prevent eddies and other disturbances from being set up in the settling compartment which might interfere with the settling efficiency, the liquid is admitted to the settling compartment in a direction opposite to that which it must take in passing thru the compartment. The clarified sewage leaves the settling compartment over eight 15-inch weirs discharging into the collecting trough.

The presence of the concrete struts in the settling compartment does not in any way interfere with the efficiency of the tank. Where necessary, they can be

capped with wedge-shaped pieces of concrete having slopes of at least 45 degrees.

In that circular segmental area between the distributing trough and the shell of the tank, all of the floating matter is collected and forms a very heavy scum, requiring slight attention from the operator.

To increase the settling efficiency of tanks of the type described, the writer uses vertical circulation. The amount of sewage thus circulated is very small and does not exceed two per cent. of the total amount of the sewage treated. To accomplish the vertical circulation mentioned, a 6-inch cast iron main with four 4-inch circular openings is laid in the digesting chamber of each tank, about 6 feet above the slot. This circulating main terminates in a small chamber located in the segment between the collecting trough and the shell, which chamber has an adjustable weir to control the flow from the digesting chamber into the collecting trough. In the Springfield plant the liquid thus drawn off is mixed with the effluent from the settling compartment and the resultant mixture is treated on the sprinkling filters. In other plants that the writer has built, the liquid drawn off from the digesting chambers is returned to the distributing troughs. Circulation such as that used in Springfield is especially of value when the sewage to be treated reaches the plant in a more or less septic condition. The Springfield plant has not been in operation long enough to determine the exact value of the circulation system.

The suspended organic and mineral matter which settles out of the sewage in the settling compartment, slides down the inclined plane thru the 8-inch slots located in the bottom of the wedge-shape settling compartments into the sludge digesting chamber. The sludge digesting chamber has a capacity of 105,000 gallons below the opening. The bottom of this compartment is formed by four cone-shaped depressions in which the decomposed sludge ultimately collects. To draw off the sludge, 8-inch cast iron sludge pipes extend down into these cone-shaped depressions, the sides of which slope at an angle of 30 degrees. The lower ends of these pipes terminate in bell-mouths supported on spiders. The sludge pipes are carried up inside of the tank to the top, giving ready access for cleaning. The sludge outlets, of which there are four for each unit, discharge under a 5-foot head into a reinforced concrete trough which conveys the sludge to the drying beds. The open channel used for conveying the sludge is preferable to the closed pipes generally used. In an open channel the sludge drawn off is at all times visible to the operator, and therefore the character of the sludge drawn off can be controlled far better than when a closed sludge conveyor is used. There is positively no odor during the operation of the sludge valves, either in the trough or upon the sludge beds.

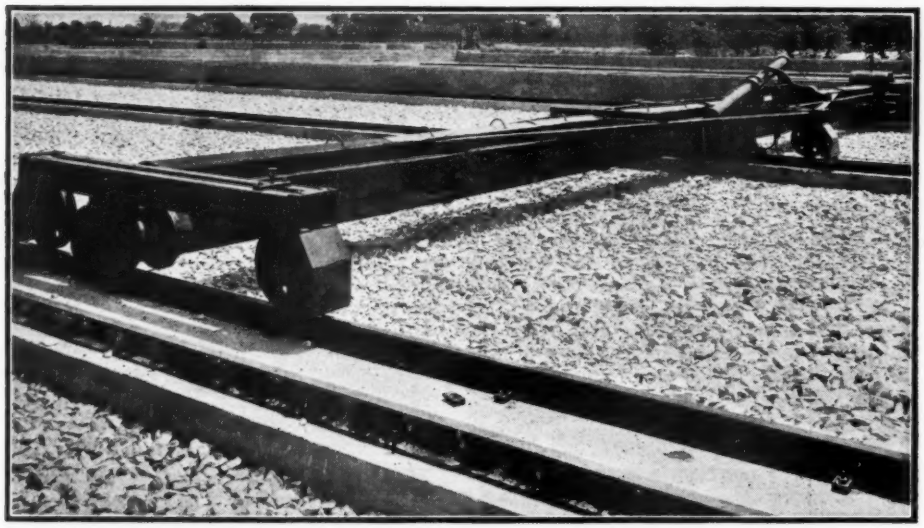
To reduce the loss of head to a minimum power driven mechanical distributers are used to distribute the sewage on the filters. These distributers were

SETTLING TANKS *under construction, showing the reinforced concrete streets, acting also as tie rods to take strains from the lobe-shaped walls.*

manufactured by the Ham Baker Company of London, England. They are designed to distribute the sewage upon the beds with a loss of head not to exceed 12 inches when the liquid is applied at the maximum rate of 720 gallons per square yard per day. Each distributer is supported on three rails, spaced 25 feet on centers. The length of the travel is 200 feet.

The effluent from the settling tanks is conveyed by a 24-inch reinforced concrete pipe to a main distributing trough located at the north end of the filters. The lateral distributing troughs which supply the traveling distributers are fed by 3-foot weirs from the main distributer. The object of these weirs is to insure a uniform distribution of the liquid to the distributers. Plate 4 also shows the construction of the sprinkling filters. The depth of the filtering material ranges from 6 feet, 6 inches in the center to 6 feet at the sides. For underdrains instead of using 6-inch channel tile, the contractor was given permission to construct 6-inch semi-circular channels in the concrete floor and cover them with vitrified tile slabs. The main collectors are semi-circular in shape, 18 inches in diameter and of variable depth, the distance between them being about 25 feet. The rails on which the distributers travel are supported by concrete girders carried by piers spaced 12 feet, 5¼-inch centers. The area covered by each distributer is enclosed by an 8-inch concrete wall. The winter temperature of Springfield is sometimes so low that it may be questionable as to whether the traveling distributers can be successfully operated in extreme weather. Should the traveling distributers go out of commission or any of them break down, it is possible to utilize the filters or any unit thereof as a contact bed to be operated by hand, suitable gates being provided for this purpose.

Extending down the center of the filters between two of the traveling distributers is a 3-foot rectangular conduit in which the normal depth of sewage is 16 inches. A cast iron siphon, 24 inches long and 8 inches in width, conveys the liquid from this trough to the distributer. This siphon is provided with a gunmetal air cock and brass air exhaust pump for starting the flow. The siphon discharges into the feed tubes, of which there are two. These feed tubes are made of wrought iron 3/16-inch thick and have an external diameter of 7⅜ inches. The feed tubes are supported at each end and at the center by a cast iron carriage braced together by rolled steel beams so as to form a rigid structure. In each feed tube just above the center are located ⅝ by 4-inch orifices, spaced about 15 inches lengthwise. The even distribution on to the beds is accomplished by a distributing tube 2½ inches in diameter, located between the feed tubes. This distributing tube is built in sections and can be raised or lowered as required to control the flow of sewage upon the beds. The feed tubes are protected with galvanized sheet iron covers provided with hinged access doors. The protection



TRAVELING DISTRIBUTER, *which sprinkles sewage over the bed thru perforated pipes fed from sewage trough at one end. Hauled by rope; motion reversed by "gun" at center of distributer.*

extends to within one inch of the surface of the bed in order to conserve the heat in the sewage as much as possible, especially during the cold weather. It also acts as a preventive of flies. A space is provided between the two channels supporting the feed tubes, which during the cold weather is to be filled with moss, leaves or other insulating material.

Each pair of distributers is operated by an endless wire cable. All three sets of cables are driven by one 6-h.p. Otto gasoline engine, which gives the distributers a speed of 38 feet per minute. The change in direction of the distributers is accomplished by means of a reversing lever.

The distributers have realized every expectation. Less than 2-h.p. is required to drive all six distributers. The writer believes that the distribution of the liquid over the bed is more uniform than can be obtained by the methods now in use in this country. The more uniformly the liquid is distributed upon a filter, the greater the quantity of sewage that can be applied to the filter to obtain the same degree of purification; or, with a given quantity of sewage, the more uniform the distribution, the greater the purification.

To the knowledge of the writer this is the first time that power-driven traveling distributers have been used in this country. The range of temperature at Springfield makes this installation an important one as indicating possible limitations of service in extreme winter weather without covering the filters.

The final settling basin is 150 feet long and 50 feet wide and has a capacity of 150,000 gallons. A reinforced concrete channel admits the sewage to the basin at the upper end and at the lower end a similar channel conveys the settled liquid to the outlet into Wilson creek. It has not been deemed necessary to sterilize the effluent.

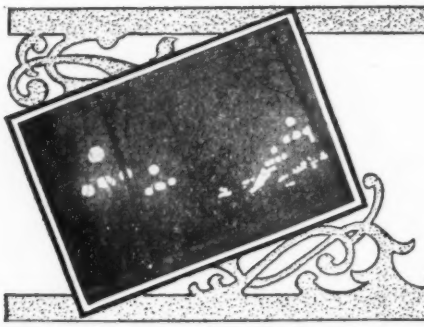
The sludge which is drawn off from the main settling tanks is conveyed by a concrete trough laid to a grade of 0.5 per cent. to the sludge beds. The sludge bed, which takes in an area of 0.35 of an acre, is divided by wooden partitions into twelve units, each unit being 25 feet wide and 50 feet long. Each sludge bed is underdrained with graded gravel 18 inches deep at the center and 12 inches deep at the sides. Down the center of each unit extends a 6-inch vitrified underdrain laid with open joints. The surface of the gravel is covered with a thin course of mortar sand to prevent the sludge from working its way into the gravel. The bed is given a slope of 1 inch in 10 feet away from the sludge inlet to assist in the distribution of the sludge over the entire bed.

Following are the latest analyses of samples of the sewage taken at various points in its passage thru the Springfield sewage disposal plant. These have been received since the paper was read from which the above description was abstracted and are of interest as showing the results of the various stages of the treatment. The report of analyses is signed by Harrison Hale, the city chemist of Springfield, Mo.

At the time these samples were taken the plant was operating at the average rate of 3,000,000 gallons a day. The samples were taken as follows: No. 275 from the crude sewage; No. 277 from the effluent of the settling tank; No. 277 from the effluent of the percolating filters; No. 278 from the effluent of the percolating filters after two hours in the final settling basin.

RESULTS OF SEWAGE TREATMENT IN SPRINGFIELD, MO.

Laboratory number	272	276	277	278
Organic	107.0	68.4	27.2	15.6
Free Ammonia	16.5	14.0	3.7	2.9
Nitrites	None	None	0.288	0.864
Nitrates	None	None	None	None
Oxygen consumed	59.3	23.8	10.0	14.5
Suspended Matter				
Total	135.0	41.2	9.2	8.8
Volatile	511.0	28.0	6.4	6.0
Fixed	20.0	13.2	2.8	2.8
Dissolved Oxygen	None	Slight trace	Trace	Trace
Temperature deg. F	69	68	67	
Total number of bacteria per cc	9,500,000	6,450,000	1,110,000	360,000
B. coli Communis in 0.0001 cc. approximate per cent. positive samples	100	95	90	65



Lighting

The Municipal Lighting Plant at Seattle, Wash.

By J. D. Ross, Superintendent of Lighting.

For the lighting of the city of Seattle, Wash., a large system has been built, comprising a hydro-electric generating station on the Cedar River, 39 miles outside of the city; two 60,000-volt transmission lines, an auxiliary water-power station in Seattle using water from the city reservoir, and an extensive city distribution system serving approximately 20,000 customers and supplying energy for street lighting. Altho this plant was briefly described in MUNICIPAL ENGINEERING, June, 1913, the information contained in this paper may be of additional interest.

Control of the entire station is brought within the reach of one operator by means of a special control board, 36 inches by 72 inches in size, designed and built by the lighting department. This board contains a diagram of the entire station, gun-metal being used to represent waterwheels and generators; nickel, exciter circuits; brass, the 2,300-volt circuits; and copper, the 60,000-volt circuits. The diagram is so arranged that each operation is seen in miniature on the face of the board, rendering confusion or mistake improbable. The meters and synchroscope are mounted on vertical panels immediately above the control board. As a safeguard in case the load drops off suddenly, three rheostats made of coils of resistance wire immersed in water have been installed, which can be connected to the station bus or to any machine, and thus prevent excessive speeds.

The generating units are placed end to end down the center of the station, with the control board on one side and the 2,300-volt switches on a balcony opposite, together with the field rheostats and switches. For transmission the potential is stepped up to 60,000 volts. There are nine 1,500-k.w. step-up transformers grouped in three banks, connected in delta on the lower tension side and in star on the high tension side, with the neutral point of the star connection grounded. The transformers are placed in a separate building next to the power house, and the high tension wiring is placed in another building, except the line switches, which are in a separate stone building. A duplicate bus system is used thruout on both 2,300-volt and 60,000-volt wiring.

The Fort Wayne step-down transformers are placed on the first floor of the sub-station. There are at present eight of these, each of 1,500-k.w. capacity at 35 degrees C. temperature rise. All are made with a ratio of 54,000 three phase to 15,000 and 2,500 Scott connected two-phase, making four banks of transformers. The secondary coils are connected in series for 15,000 and in multiple for 2,500 volts, two banks being used for each voltage. Under careful test these transformers showed a maximum efficiency of 98.5. The all-day efficiency was found to be 96.6 per cent for 1911.

The distributing system was first designed for three-phase star connection, but as there were two large companies in the city, both operating two-phase, the plans were changed to make it possible to interchange motors without special transformers.

The series street lighting comprises 683 miles of No. 6 wire divided into 29 circuits, lighting 601 miles of streets. The circuits are connected two in series 6.6 ampere 100-light air-cooled Fort Wayne constant circuit transformers. Each of these is equipped on the primary side with a small solenoid-operated oil switch made by the department, and with a test board with plug switches. This arrangement keeps all pressure above 125 volts away from the switchboard. The voltage on the circuit varies with the number and kind of lamps from 2,500 volts to 500 volts. In all there are 692 6.6-ampere arc lamps, 5,315 40-c. p. tungsten lamps, and 199 300-c. p. tungsten lamps. The large tungsten lamps were manufactured especially for the department by the

FOURTH AVENUE, LOOKING NORTH FROM YESLER
HOTEL REYNOLDS

General Electric Company. They have proved satisfactory in every respect, giving steadier, better distributed light and averaging over 2,000 hours of life. The 40-c. p. tungstens are mounted by "goose necks" on the line poles. This type of lamp is ideal for its purpose, since it gives light in small units at a minimum cost for maintenance and power.

The test of the series lighting circuits shows an all-day efficiency for 1911 of 86.3 per cent. from the switchboard to the lamp. The loss in the transformers was 5.0 per cent., and in the line 8.7 per cent.

Seattle's cluster lighting system is one of the finest in existence and is generally admired by tourists and visitors from all parts of the country. The main business avenues are lighted by five-lamp poles, placed opposite each other at the curb line and spaced 80 and 90 feet. The usual design of a five-lamp pole places four globes in the form of a cross, with one center top globe. The Seattle poles, however, have the lamps placed in a triangle perpendicular to the sidewalk, with a 16-inch globe at the top, two 14-inch below and two 12-inch globes, turned downward, at the base of the triangle. All the globes have a light sand-blast finish. This design gives a beautiful festoon of decorative lights along the sidewalks, and at the same time secures a uniform illumination on all parts of the street. The intensity on the sidewalk carries from 0.32 to 0.79 foot-candles, and at the center of the street from 0.34 to 0.45 foot-candles. This illumination, which is ample, is produced by using 50-watt tungsten lamps fed from the small transformers in the pole base at a pressure of 8 volts. This type of lamp was designed by the General Electric Company especially for the lighting department and has proved so satisfactory that it has since been made standard by that company. The average life of this lamp has proved to be over 2,000 hours.

In residence districts, where lower illumination is sufficient, three-globe poles are used, similar to the five-globe poles with the two lower globes omitted. In the parks and along the driveways a single 20-inch globe, with a 75-watt 12½-volt lamp is used. Altogether, there are 1,116 five-ball poles lighting 13.5 miles of streets, 378 three-ball poles lighting 8.5 miles, and 137 one-ball poles lighting 3 miles of street, making a total of 1,631 poles lighting 25 miles of street.

In the business district the system is fed from the underground mains placed near the curb line. The main feeders are placed in vitrified clay ducts with the commercial feeders, and the branches are run in fibre conduit cased with concrete. An exception to this is made when the ducts run under the walk where a basement is to be excavated. In these places steel conduit is used, placed just beneath the sidewalk. Manholes for transformers are placed below the sidewalk at street corners, about three blocks apart. Five, ten and fifteen kilowatt transformers are used, all on one street being alike. These transformers are connected to feed both ways from the manhole, the lamps in each section of street being fed from one secondary coil of each adjacent transformer. A three-wire lead-covered secondary cable is used, so connected that the blowing of a fuse will leave each alternate pole dark, and so leave the street fairly well lighted. The secondary voltage is 120-240 stepped down to 8 volts by the pole base transformers.

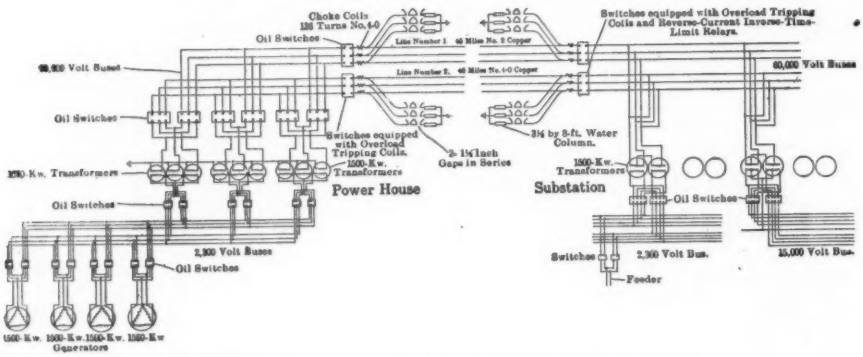


DIAGRAM *of connections on special control board.*

A municipal plant must adhere to uniform rates at all distances from the station much more closely than a private concern, altho the cost of current delivered in distant suburbs is greater; the question of cheap transmission to suburbs has therefore been carefully studied. The economic distance to which 2,500 volts could be carried was computed from the cost of material and labor, interest on bonds, and net value of current per k.w.

per annum, and beyond the economic distance sub-stations were installed with supplies at 15,000 volts and distribution at 2,500 volts, giving better economy and regulation. One of these at Fremont, distant 19,200 feet from the substation, has a capacity of 1,500 k.w. at 40 degrees C. temperature rise. Another at West Seattle, 26,000 feet distant from the sub-station, has a capacity of 500 k.w. at the same rating. A similar substation has been completed at Hillman and a site purchased for one at Ballard. For mechanical reasons No. 2 is the smallest wire used for the 15,000-volt transmission. These lines travel largely along the water front on Puget Sound, where the new canal will bring a considerable number of industries. In all, these lines traverse 10.7 miles of water front and will eventually follow the entire water front of both salt and fresh water.

It is obvious that some system would be ideal that would supply all large industries from the 15,000-volt lines direct, leaving only the lighting of the suburbs beyond to be handled by the sub-stations, thereby requiring much smaller transformers and giving vastly better regulation. It was also desired to use pole-type transformers except for very large loads. A three-phase star system was the nearest approach to the ideal then in use and a system was therefore designed for the purpose, using a two-phase 15,000-volt system, the center point of each transformer being brought out and connected to a fifth wire which was grounded frequently along the line. This system gives in reality four circuits for the two phases. Power is transmitted at 15,000 volts, but is distributed along the line for large power and lighting loads at 7,500 volts, stepping to the supply voltage desired. To this end 7,500-volt transformers the placed on poles in the usual way and connected from the outside wire of a phase to a neutral wire, as in the ordinary three-wire system. Submarine cables have 15,000 volts between wires but only 7,500 volts to lead sheath. This system has given entire satisfaction and makes sub-station work easier by eliminating large power loads from the automatic regulators.

PROGRESS IN PUBLIC LIGHTING

During the past year the science of illumination has probably made greater progress than at any other similar period of its history. While few radical changes or developments have been made in connection with light sources, improvements have been made in mechanical construction of present systems, resulting in increased efficiency, and illumination has become the subject of study by physicists, oculists, architects, legislative bodies and others as never before. The progress in public lighting reported by a committee of the Illuminating Engineering Society is measured first in improvement of lamps.

In this connection the development of the tungsten lamp stands out most prominently. This, in high candle-powers, is a serious competitor of the arc lamp both for indoor and outdoor lighting, and has largely superseded the carbon filament lamp, as shown by the following table taken from a recently published article giving the relative number of lamps sold.

It is extremely probable that more recent figures will show that the tungsten lamp, aided by greatly reduced price, its high efficiency and the fact that electric companies are beginning to make free renewals of tungsten lamps as they did of the carbon filament, is destined to make the carbon filament lamp a vanishing quantity. In this connection it is interesting to note that the United States government has issued an order thru the office of the supervising architect of the Treasury Department that carbon and metallized carbon-filament lamps are not to be used in any of the government buildings, and any such lamps in use at the time of the receipt of the order must be removed and 25-watt tungsten lamps substituted.

There has been marked improvement in the life of some of the higher wattage 100-volt types and in compensator and train lighting lamps. In the 60, 100 and 150-watt, 100-volt lamps improvements in life have taken place similar to those

Type.	1907 Per cent.	1908 Per cent.	1909 Per cent.	1910 Per cent.	1911 Per cent.	1912 Per cent.
Carbon	93.27	84.12	68.98	63.08	52.90	25.47
Gem	5.88	8.58	15.07	14.88	19.00	33.59
Tantalum	0.75	1.78	2.12	3.57	2.74	1.00
Tungsten	0.10	5.52	13.83	18.47	25.30	39.94
Total	100.00	100.00	100.00	100.00	99.94	100.00

made last year in the cases of the 250, 400 and 500-watt lamps. This improvement in quality is on the order of 50 per cent. in life and has made possible substantial improvements in efficiency. The use of chemicals—the so-called "vacuum getter," in the bulbs of these lamps for reducing the blackening of globes has largely brought about these improvements. At present the commercial efficiencies of these types are around 1.17 w.p.c. while the higher wattage types are put out at about 1 w. p. c.

¶ MERCURY *vapor lamp and the tungsten have been combined, producing a white light very suitable for street lighting.*

Improvements in the tungsten wire-drawing process have made it possible to manufacture wire of almost exactly the desired size and so render it possible for manufacturers to make lamps of so nearly the desired voltage and efficiency that the function of photometry in the lamp factory is now principally to guard against errors in manufacture. This improvement has been adopted by most of the manufacturers in this country for all lamps intended for series burning service and has been productive of greatly improved results in all cases.

A 10-watt, 100 to 130-volt lamp and a 5-watt, 50 to 60-volt lamp have been developed. These are important additions to the line of sign lamps in that they furnish a low wattage lamp that does not require the operation of more than two lamps in series upon 100 or 200-volt circuits.

A new filament consisting of an alloy of tungsten has also been brought out. It is claimed that this not only possesses the strength and efficiency of drawn tungsten, but that it will withstand crystallization for a longer period.

Possibly the most startling development in the tungsten lamp is the announcement of one giving an efficiency of 0.5 watt per candle. A specially shaped tungsten filament is used in a bulb containing an inert gas, as nitrogen, at a pressure of about one atmosphere. The types to be developed first are adapted to high current consumption, say 6 amperes and over.

A tungsten lamp has recently been brought out which gives a color very closely resembling that of daylight. The energy consumption of this lamp is about 1.4 watts per candle, and it has a candle-power of from 70 to 75.

The open and enclosed series and multiple arc lamps are fast disappearing, their places being taken by the magnetite and the flame arc lamps. There seems to be during the past year, as far as arc lamps are concerned, a strong tendency towards the use of larger units and the cutting down of the intrinsic brilliancy of the arc even at a sacrifice of efficiency.

The flame arc lamp is of special value in lighting large areas, and is particularly adapted to smoky and dusty places, such as foundries, blacksmith shops, and railroad train sheds. In fact one of the largest railroads in the country spent months in trying out various systems of lighting for the train shed of one of their large stations, and, after experimenting with various systems of lighting finally decided to use the flame arc lamp exclusively, adopting it also for the yard.

This lamp has been improved so that the fumes thrown off by the arc condensed and so are prevented from forming a deposit on the globe and from escaping into the air. The lamp is also economical as far as maintenance is concerned, as one set of carbons will burn from 100 to 120 hours without attention.

A rather novel device is an arrangement for converting any enclosed arc lamp, alternating or direct current, series or multiple, and regardless of voltage, into a flame arc lamp.

¶ IMPROVEMENTS *in wire drawing have made possible the making of lamps of almost any desired voltage or efficiency.*

One of the more recent developments of the mercury vapor lamp is a combination with the tungsten, an apparent white light being thereby produced. The unit is very compact and is furnished with a novel starting device. The consumption of this lamp is claimed to be 0.73 watt per mean hemispherical candle-power. Another recent form of mercury vapor lamp is one with a specially designed quartz tube and designed particularly for street lighting. This lamp is started by means of a heated spiral which vaporizes a small portion of the mercury; this is automatically cut out of circuit when the lamp is in operation, and renders tipping unnecessary. The lamp is recommended for the varying voltages met with on traction circuits and is said to consume about 0.4 watt per candle.

The value of the ultra-violet rays of the quartz tube mercury vapor lamp is becoming recognized. The lamp is now used for sterilizing and the destruction of bacteria. This effect, however, decreases in time, due partly to the formation of an obscuring deposit.

A large number of new types of gas lighting units have made their appearance in both hemispheres. Some of them have been designed with a view to more universal adaptability, such as a burner with a curved bunsen which may be turned either up or down and is therefore, applicable to either upright or inverted burners; some with a view to ease

of maintenance, such as one in which the main feature is the possibility of lifting from the fixture, without the use of pliers; and some with a view to increased efficiency, such as one in which the mixture of gas and air issue at high velocity, resulting in an efficiency claimed to be double that of the standard type; also another lamp with an upright bunsen and an inverted mantle. Low-pressure high-efficiency lamps, particularly for out-door use and giving 1,500 candle-power and with an efficiency of nearly 40 candles per foot have been introduced abroad, but have not yet appeared in this country.

¶ A GAS *mantle has been produced capable of giving* 180 *to* 225 *candle-power. This high-power single mantle allows greater range of globe design.*

What is probably the most important development in gas lighting during the past year is the introduction of a high-power single-mantle inverted lamp filling a place between the old small unit and the multiple mantle lamp. The lamp gives from 180 to 225 mean spherical candles according to the gas used and the pressure, and thus occupies a space hitherto unfilled. A valuable feature of this lamp is the fact that, because of the single mantle the light is concentrated and reflectors and glassware may be designed with much greater precision than with the multiple mantle lamp.

Hitherto one of the difficulties in connection with the use of high-pressure lamps was the heat developed which limited the kinds of glassware available and also necessitated a globe of very great size. In a modification of one of the high-pressure inverted lamps now in wide use, particularly in England, a small silica cup about 5 inches high, and therefore but little larger than the mantle itself, has been substituted for the globe hitherto used. This cup totally excludes the secondary air supply, all air for combustion being admitted as primary air. The lamp, moreover, is greatly reduced in size and the reflector is omitted. It is claimed that after allowing for the absorption of light by the silica cup a 10 per cent. increase in efficiency is obtained. These cups are made for lamps of from 60 to 1,500 candle-power. They are very durable and will not break if the mantle gives way and the flame strikes them.

A new high-pressure lamp has also been developed in the United States, designed particularly for street lighting, and working under a pressure of 55 inches of water or 2 pounds per square inch. These lamps are at present made in two sizes—500 and 1,100 candle-power respectively and have an efficiency of over 50 candles per foot of gas per hour. The mantles are of artificial silk and have a life of over 400 hours with practically no depreciation in candle-power.

Automatic gas ignition is having a steady growth. Pilot lights are increasing in number, while the jump-spark and filament igniters are gradually coming into use. Distance control by means of electrically operated gas cocks and also pneumatic control in connection with pilot and jump-spark ignition are being extensively employed, particularly in the past year. It should be noted here that pilot lights have been improved by adopting the bunsen principle and by better protection, so that the danger of extinction is greatly reduced. Self-kindling mantles are also receiving attention, and one improvement recently made in this type of mantle was to mix ammonium chloride with rhodium chloride.

The use of acetylene is increasing for isolated buildings and for distribution from a central plant in very small towns. A large number of burners are available to suit varying needs, but as yet no incandescent burner has been devised for use with acetylene that is thoroughly satisfactory.

¶ A NEW *gas arc developed, for which* 1,200 *candle-power is claimed.*

Air gas systems and systems employing kerosene under pressure for use in connection with incandescent mantles are making considerable progress in the rural districts and other places not reached by city gas and electric plants. The former system, however, has had a setback in the increased price of gasoline and the difficulty in obtaining the high grade necessary. A new modification of the latter system consists of a gas arc lamp connected with the fuel tank by a fine flexible bronze tube. Laboratory tests showing 1,220 candle-power are claimed for this lamp.

The question of street lighting is attracting extraordinary attention. People are no longer satisfied with just enough light to see to move around safely, but are coming to a realizing sense of the advertising and artistic values of ample light. White Ways are almost as common as towns themselves, and where the cities do not seem inclined to install them, the merchants put them in by private subscription. The open arc lamp is a back number, and in many cases the enclosed arc, once so universal, is giving place to magnetite or flaming arcs, or to clusters of tungsten lamps on ornamental poles. The old, severely plain iron or wooden pole is rapidly giving way to the artistic post, and there is a strong tend-

ency to recognize the artistic as well as the utilitarian.

While much publicity is being secured to ornamental lighting, the majority of the business, however, has been connected with the ordinary street lighting, which is, in the electric field, practically working in the direction of the use of the luminous arc lamp, and the tungsten filament incandescent lamp. The increased standard of general street lighting has been largely accelerated by the reduced cost of light, and while it has taken on no distinctively new form, the standard of lumination intensity (not necessarily size of units) has been raised very considerably.

¶ RECENT TESTS *show that twenty-five out of twenty-nine persons favored metallic-filament lamps because of less eye-strain than with arcs.*

An interesting test was made in Switzerland to find the relative advantages of arc and metallic-filament incandescent electric lamps. Two streets of equal length were lighted with 10-ampere electric lamps and 500-candle incandescent lamps respectively. The choice between the two forms of lighting was left to 29 trolley car motormen. Of these 25 favored the metallic-filament lamp on account of lessened glare and irritation to the eyes. The mercury-vapor lamp has been suggested as a street lighting unit, but thus far its use for this purpose has been hardly more than a suggestion, altho in one city lighted by a municipal electric plant, a group of merchants installed six quartz tube lamps to show by contrast the poor character of the general street lighting.

During a "street show" in one of our large cities, ornamental pillars each carrying three electric light globes were erected. Panels in these columns were made transparent by making them of wire netting and coating them with varnish of various colors, giving the effect, when lighted from the inside, of art glass.

In the ornamental lighting system, it is frequently desirable to turn off the lamps without affecting the rest of the circuit. This is done in at least three towns by various systems of pilot wires and magnet switches centering at the central station or other convenient point. In this connection may be noted a method of controlling from the central station switches on a network by superimposing a ripple on the regular voltage. In another town a switchboard has been placed in the office of the chief of police so that in case of burglary or fire alarm after the regular time of shutting off, the ornamental system of street lighting may be turned on.

An unfortunate dispute has arisen in one of the large cities of England over the relative merits of high pressure gas and flaming arc lamps. Two streets were lighted by the rival illuminants and experts representing each of the industries made illumination measurements and prepared reports. The tests were entirely in favor of the electric lamps, but the fact was brought out that the gas lamps were improperly adjusted and installed, so that no conclusions could be drawn as to the relative merits of the two systems. The whole affair caused much argument and a good deal of acrimonious discussion on the part of the advocates of the two systems.

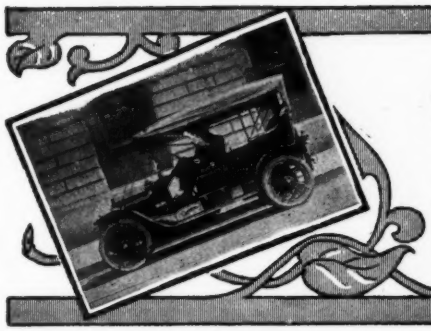
Gas street lighting has made great strides in both England and continental Europe, where high pressure lighting is in great favor. Automatic lighting of gas lamps is also making rapid progress on the other side of the Atlantic, the lamps in a large number of towns being equipped with these appliances. Two systems of automatic lighters are in extensive use, one being operated by a momentary addition to the street main pressure and the other by means of a clock arrangement on each post so that the lamps operate individually and independently. Highly encouraging reports as to the satisfactory and economical working of these systems have been made.

In this country street lighting by gas, while making steady progress, has not experienced the rapid growth that is so marked abroad. Automatic lighting has not as yet obtained a foothold here, and except for two minor installations, there is no high-pressure street lighting. Another difference between European and American practise is that abroad inverted burners are becoming the universal practise, while here, except for a two-mantle 150 candle-power lamp, the inverted burner is not used.

Ornamental street lighting by gas is spreading, a number of prominent installations having been made.

It may be of interest to note that one of our public utility commissions, which had been investigating the street lighting in a large city of the state, recommended that the city employ an illuminating engineer, to be retained permanently if possible, for the purpose of selecting the type of lamps to be used and to fix their location.

Increased interest in street lighting does not seem to be unusual, however, as a recent item in a French technical journal contains the statement that in that country, out of 10,000 villages or communes of more than 1,000 inhabitants, 6,000 are without public lighting.



Automobiles in Municipal Service

Care of Automobile Fire Apparatus

By D. J. McCue, driver of Packard Auto Combination Chemical and Hose Truck, North Bradford, Pa.

A systematic daily routine is necessary in order to properly maintain fire apparatus so that it will operate at its highest efficiency at all times. One of the most important phases of such routine in our station is to first test the motor for compression, ascertaining that it is equal in all cylinders. One weak cylinder will cause a loss of power and often decided missing. Thus when operating upon three cylinders in place of four, the three operating cylinders are dragged own by the one which is inactive. If a fault of this character is not discovered prior to a run serious consequences may develop.

For instance, suppose that upon the last run of the day just before retiring the motor operated correctly. It pulled that last 18 per cent. grade on second gear without a hitch. It came into quarters in apparently perfect working order. The next morning the usual process of cleaning up, polishing brass, inspection of wiring and connections, etc., was made but the driver failed to turn the motor over by hand. He did not test his car for compression inasmuch as it seemed to fire on four cylinders when running idle. The driver then proceeded to clean up. In the course of an hour an alarm was sounded. The alarm called for a run up the hill which had been pulled so successfully the night before. That meant an 18 per cent. grade. The machine left the quarters with its 5-ton load and after some coaxing attained a speed of 30 miles an hour on level streets. Two hundred feet up the grade it became necessary to drop into second speed and with the throttle well open the engine proceeded to drag and drop behind the speed it should maintain on second gear. It then became necessary to use the first or lowest gear and finally the hill was negotiated but not without much worry upon the part of the driver who was in the habit of taking the grade with ease. The apparatus arrived at the fire five to six minutes later than necessary. Everybody, including the firemen, wondered why the powerful and reliable Packard fell down at such a crucial moment. It became necessary to throw two large streams to save what was left, where, under ordinary conditions one 25-gallon chemical tank would have quenched the fire with a comparatively small loss.

Upon arriving at the station a careful inspection developed that on the run the night before the lock nut on the valve push rod had become loose and had worked up four or five-thousandths of an inch, just enough to prevent the exhaust valve from seating properly, thereby causing a loss of compression.

This is but one of the number of things which may happen if the daily routine is not systematically and rigidly carried out.

After receiving the Packard truck now in use in this department we found that it was absolutely essential to develop a routine and to see that this routine was rigidly adhered to in order that the most efficient results could be secured at all times. The result has been that the car has never missed an alarm since April 10, 1911, and it has never taken longer than eight to ten seconds to get the car out of the station.

It has been my experience that a greater amount of attention is necessary when a truck is new than at any other time. This is particularly true of a number of important parts, most particularly the braking system. It is necessary that the brakes be adjusted and that the spring clips be taken up after nearly every run during the first year. It is absolutely essential that a piece of high-powered motor apparatus, which is designed to travel over the streets at excessive speed thru congested districts and in the midst of excited traffic, shall be at all times equipped with the very best of brakes. In order to accomplish this the braking system must be kept in constant adjustment. We find the best method of mak-

ing this adjustment is to jack up the rear axle and rotate each wheel, at the same time noting the resistance of the brakes and adjusting them to operate with as nearly an even pressure on both wheels as is possible to secure.

Of equal importance is the steering apparatus. This should be examined thoroly for any broken bolts, missing nuts or loose connections. On machines which use solid tires, all shocks from rough pavements and roads are transmitted to the steering connections to a much greater degree than where pneumatic tires are used. On machines so equipped it is necessary to maintain frequent and rigid inspections.

Machines which are driven by chains require frequent adjustment in order that the maximum amount of power can at all times be transmitted to the road. This adjustment is made by shortening or lengthening, as necessary, the radius rods on each side of the truck and then being careful to ascertain that the distance between each of the sprocket wheels and the rear axle is the same so that the rear axle will remain square with the frame. If such is not the case both tires and chain will wear unduly.

Such parts as are apt to break frequently should be carried in stock. We always have on hand an extra supply of spark plugs, gaskets, carbureter springs, small magneto parts, etc. Each station should be equipped with the proper tools to work with so that when work is started on a car it can be carried thru expeditiously.

We keep a regular day sheet on the maintenance of our cars. At the end of the month a summary of the day sheets is copied to a monthly record sheet. In this manner daily and monthly costs can be arrived at. The day sheets are headed as follows:

Day of the month.
Number of runs.
Total miles.
Gallons of gasoline.
Gallons of cylinder oil.
Gallons of gear oil.
Gallons of transmission oil.
Graphite grease (pounds).
Tire repairs and replacements (R. F., R. R., L. F., L. R.).
Cost of repairs.
Miscellaneous supplies.

The monthly sheet has the following headings:

Month.
Driver's wages.
Accident repairs.
Routine repairs.
Interest.
Depreciation.
Insurance (liability, property damage, fire and collision).

Daily inspection is not complete until spark plugs have been tested, all wiring connections tightened, batteries tested, radiator and gasoline tank filled, grease cups turned down, tires properly inflated, skid chains in good condition and other minor points attended to, all of which must be in proper condition in order that time shall not be lost when calls come in or on the road.

Maintenance of Motor Driven Fire Apparatus

By O. B. Mercer, Chief of Fire Department, Westville, Conn.

The most important thing in the care of motor fire apparatus, is to keep the engine in perfect running order, and to watch the tires, especially where pneumatic tires are used. The motor should be started at least twice a day, morning and night. If it is a piece of pumping apparatus, the pump should be tried out at regular intervals, providing it has not been in use. After every alarm, or more especially after pumping at a fire, the whole machine should be gone over carefully and all bolts and nuts tightened, spark plugs cleaned and the machine well greased. Test the compression and see if the valves need grinding.

Keep the gasoline and oil tanks full at all times. It is a good plan to prime the engine with gasoline after the regular starting period, as this will enable the engine to start immediately in case of alarm. If the piston rings and valves are tight the engine will start from compression after priming and it will not be necessary to crank the motor.

Oil and grease engine at regular periods. Watch steering knuckles and keep them tight. Keep the wheels of machine well greased, packing front wheels about every three months. In greasing, I find it advisable to use a lighter cup grease in winter than in summer. The grade of grease used in summer generally becomes so hard that it does not work into the bearings in the winter, until they are altogether too hot. Don't try to cut down expenses by buying a cheap cylinder oil. It is better to pay a fair price and get a good oil that will not carbonize rapidly and that will keep motor from over heating.

If the engine is heating look for carbon, see that water is circulating and try compression. If it is not the same on all cylinders, the valves need grinding and should be attended to at once, otherwise the motor will not develop its full power. It is well to try valve push-rods and take up any shake, as this will cause the engine to be noisy and in time lose power.

If the motor back-fires into carbureter the usual fault is too great a quantity of

air and this should be cut down. If the mixture is too rich the engine will probably fire a charge in the muffler, and is also liable to back-fire after switch is turned off. This back firing is not always caused by too rich a mixture, but may be caused by carbon. An overly rich mixture will invariably cause overheating.

There should be two entirely separate ignition systems, one for storage battery and one for magneto, using two sets of spark plugs. This is necessary because one is liable to go wrong and where there are two systems one is always available. The magneto should be wired so that it is not necessary to use the coil, also the magneto should be of a type that will start engine by spinning. Great care should be taken in buying, to see that magneto and battery do not use the same coil. In this case if coil went wrong it would kill both systems. If there is a storage battery on the machine, it should be tested at regular intervals, altho I should prefer to have dry batteries and keep two sets on machine at all times; this may seem expensive but in our case it proved just the opposite, as we were continually having to send storage battery away to be recharged, which leaves the machine with only one ignition system, unless there are two storage batteries, and with dry batteries you can change from one set to the other or get new batteries without a twenty-four hour wait, which is necessary when a storage battery is sent to be recharged. We have had two sets of dry batteries in use over a year and are still using them. In buying, the battery question could be overcome by getting apparatus with a self-starter, which charges its own battery. The same starting rules would apply to self-starter as before stated, inasmuch as a self-starter is just as liable to go wrong as any other part. Every one has his own idea as to which is the best magneto, but we have had perfect results from the Bosch magneto, the motor starting as quickly on the magneto as on battery. Our battery system is the Atwater-Kent from which we have had the best results during the past three years. Extra spark plugs should be kept on hand at all times.

Jack the machine up on swivel jacks when standing idle; it doubles the life of the tires and the swivel allows one to run off without lowering. Jacks need only be used where there are pneumatic tires, and when they are used the machine should be lowered to the floor at least once a day, as the tires are liable to leak and can be tested best in this way.

Demountable tires should be used and a spare tire kept on hand at all times. Keep the tires inflated to the pressure recommended by the manufacturers, as tires that are run soft are liable to cause friction and consequent cracking of the inside of the casing, which will eventually pinch the tube, causing a bad leak.

TEST *of motor driven pumping apparatus, Westville, Conn. During fourteen and a half hours pumping forty gallons of gasoline and seven gallons of oil were used.*

I would recommend the use of a floating strip in tires as this will protect the inner tube for a long period. The life of the tire can be lengthened by having a small vulcanizer on hand and whenever a cut shows on casing, it should be vulcanized at once as this will keep water and sand from getting between rubber casing and fabric, and prevent the fabric from further damage and rotting. This I find is very important.

It is advisable to keep chains on the rear tires at all times. In place of chains some prefer non-skid tires. We have found that chains give us better results and in three years use have not damaged our tires in any way. This might not apply to a car that is running two or three hundred miles every day, but with fire apparatus the runs are generally short and only taken once in awhile. I think chains are safer. Cross bars on

chains will wear out rapidly but can be replaced at a nominal cost and with very little trouble.

Cost of maintenance will vary with price and the amount of running down. In our case we have blown out two shoes and bought five new tubes in three years. Tires are the greatest expense, barring accidents. In 14½ hours of pumping we used about 40 gallons of gasoline and about 7 gallons cylinder oil. The engine was lifting her own water and being forced to limit most of the time.

Since having motor apparatus we have extinguished more fires with chemicals than we ever did with the old system.

The beauty of motor apparatus is that when you have arrived at a fire the driver can become an active fireman. The machine needs no one to watch it, unless it is a pumping engine, and in that case driver acts as engineer. The expense of keeping motor apparatus is very small unless it is in a very busy house. The apparatus costs nothing when not in use.

One of the very important features in buying apparatus is to have it equipped with large enough tires to carry its maximum load. Under-size tires will cause serious trouble in all directions. The larger tires are more expensive, but only in the first buying and will prove cheaper in the end.

The Motor Driven Combination

By A. P. McDavit, Chief of Fire Department, City of Dover, N. J..

We have recently installed a White motor-driven combination chemical and hose wagon. While we have not been operating this piece of apparatus for a sufficient length of time to give detailed figures as to its cost of operation and maintenance as compared with horse-drawn apparatus, we have demonstrated that it is more convenient, economical and speedy as far as fire fighting purposes are concerned.

In most cities using chemical engines or combination chemical and hose wagons, reports state that at least 75 per cent. of the fires are extinguished by chemicals alone. In all probability, the general use of the auto combination will increase this percentage to 85 or 90 per cent. owing to the speed in arriving at the fire consequently the more general use of the chemical tank attached.

The motor-driven combination hose and chemical, in nine cases out of ten, furnished all necessary fire fighting equipment. There is no question in a city of sufficient size and wealth to warrant it, that the maintenance of more wagons with smaller combinations than the triple, is of greatest advantage and will give better service, especially in that most important matter of quick service and speed. If it is a small fire, you have the chemical, and in quantities almost as great as that carried by the chemical alone, and if the water hose is necessary, you would have it in as great quantities as carried by the hose wagon alone.

The motor-driven combination can be used for many different purposes; as an ambulance, it will be the means of saving the lives of those overcome by smoke or gases, or who have been injured in other ways, by affording quick transportation to the hospital; as a fuel wagon, fuel can be furnished the engines more expeditiously, especially when the engines are at some distance from the supply base.

In using horse-drawn apparatus, if a horse falls and breaks a leg, the horse must be shot, but with the automobile repairs are made and the apparatus is as good as ever; and it is my belief that there will be less failures to arrive in response to alarms with the auto apparatus than with the horse-drawn apparatus. There are no horses to feed when the machine is not in use and the expense is practically nothing when not actually in service. Comparing with the horse: The automobile can get to the fire quicker; is more reliable; never tires; only fed when working; less danger of accidents, being under better control of driver than horses; driver to be used as fireman; takes less room; no stable; no attraction or breeding place for flies; less cost of maintenance.

The motor-driven combination hose and chemical is a great success in handling brush and grass fires, getting on the job so much quicker than horse-drawn apparatus that the fire is still of no great extent and so will be handled in much shorter time and the apparatus and men returned to station ready for the next run, the auto apparatus making quick returns as well as quick responses.

Looked at from the economical side, there will be a great saving in space occupied, so that new stations may be much smaller, lots purchased may be much smaller, and the total expense will also be correspondingly reduced. Cost of heating and lighting and water bills will be reduced. There will be a saving of one man as the driver will have no horses to watch and can be used as a fireman in fighting the fire.

We can cover a much larger territory, so, altho we must have enough apparatus and equipment for the very large fires. I think the time will come when more apparatus will be kept as a reserve and possibly a reserve force of men to be called only in time of a very large fire.

Our new combination, which was furnished us by the White Company, Cleveland, Ohio, has 6-cylinder, 60-h.p. engine

with an electric starter and employs the Kanawha air system for chemical pressure. Twelve hundred feet of 2½-inch hose are carried in a steel hose bed which is quickly accessible from the rear running board. The bed occupies the conventional position between the two seats running lengthwise of the truck. The seats, capable of seating eight men, have good cushions. Under the seats are lockers. Portable chemicals are strapped to the running board and the large nozzles for the 2½-inch hose are carried on posts that are built on the rear running board. Hooks, lanterns, axes, etc., are carried along the side of the body, a 50-gallon chemical tank is mounted in the customary place in a recession between the driver's seat and the hose bed, while the chemical hose, 250 feet long, is coiled in a steel basket immediately above the chemical tank. For this class of apparatus, where seconds count in getting under way, the White electrical starting system is particularly valuable. It has the unusual advantages of preventing the motor from stalling at all times and without any attention on the part of the driver. Both the functions of starting and lighting are performed by one mechanism, the motor generator, which is mounted at the forward left side of the engine and driven by silent chain. The entire control is centered in a single knife-blade switch located on the dash. When the driver has closed the switch, the electric system assumes its duties and performs every function without any further attention and without the assistance of any automatic regulating devices. Both the control of the generator capacity and the change of its functions from that of a generator to a motor are accomplished entirely by the design of the unit itself. Closing the switch connects the 9-cell battery and puts the electrical pressure above or below that of the battery. At engine speeds above a certain definite point it is a generator and below that point it becomes a motor, so that should the engine stall in traffic the electric motor will automatically "pick it up" and restart it without any attention on the part of the driver.

Motor Driven Fire Apparatus as an Investment

By J. E. Shrewsbury, Chief Engineer, Fire Department, Long Beach, Cal.

The city of Long Beach has one Robinson Jumbo pumping engine with a rated capacity of 700 gallons per minute. At the acceptance test it drafted from the reservoir and delivered 715 gallons per minute. For the year preceding July 1, 1912, it achieved the following record:

Alarms answered, 34.
Distance traveled, 158 miles.
Pumped at fires, 4 hours, 50 minutes.
Pumped at drills, 1 hour, 30 minutes.

Expenses.

Gasoline, 158 gallons, at 18c....	$ 28.24
Cylinder oil, 15 gallons, at 42c..	6.30
Kerosene, 15 gallons, at 9c.....	1.35
Hard oil, 5 pounds, at 15c.....	.75
Spark plugs, 3 at 50 cents.....	1.50
Repairs on strut rods.....	2.00
Driver's salary, 12 mo., at $95...	1,140.00
Total cost maintaining auto..	$1,180.14

For comparison's sake I submit a conservative statement of the cost of maintaining one-third size steamer for the same period of time:

Engineer's salary, one year....	$1,200.00
Driver's salary, one year.....	1,020.00
Feed for two horses, one year..	360.00
Horseshoeing	48.00
Fuel for heater	324.00
Coal	30.00
Oil	2.00
Total cost maintaining engine.	$2,984.00

In addition to that, there is the cost of maintaining the hose wagon as tabulated below:

Driver's salary, one year	$1,020.00
Feed for one team, one year....	360.00
Horseshoeing	48.00
Total cost maintaining hose wagon	$1,428.00

Thus it is demonstrated that the cost of maintaining a third-size steamer for one year is $2,984.00, and its hose wagon $1,428.00, which makes a total of $4,412.00 for the steamer and wagon for one year, as against $1,180.14 for the auto engine combination complete, which is a saving of $3,231.86 in favor of the auto rig per annum. In other words, the steamer equipment, complete, costs 273 per cent. more per year for maintenance than the auto engine equipment.

Our auto engine has covered all outside territory, making some runs of 3 miles length, and has never given us any trouble. It also answers all second alarms in the business district, while the steamer covers a radius of not over a mile from the central station. The auto engine has made a speed of 35 miles per hour, but we have a limit of 25 miles per hour when answering alarms. The driver has orders to drive slow on rough roads, never driving at a higher rate of speed than will permit him to maintain perfect control of the machine at all times.

When working at fires the engine should be kept at its normal speed when possible, and the pressure regulated by means of the by-pass and relief valve. I

find on long lines, where a good pressure of from 175 to 200 pounds is required, that by running the engine at full speed and opening the by-pass, the engine handles the stream to better advantage than in any other way.

On September 3, Ocean Park, Los Angeles county, experienced a serious conflagration. When they called on Chief Archie J. Eley, of the Los Angeles department for assistance, he immediately ordered that engine number 26, which is also a Robinson "Jumbo" similar to our engine, carrying its own hose, and the auto hose wagon, number 5, be despatched to their assistance. The auto engine covered the 11 miles and had water on the fire in 27 minutes. He also ordered that two steamers be sent at the same time, and they were accordingly loaded on cars and shipped to Ocean Park, 2 hours and 45 minutes elapsing between the time they were despatched and their arrival. It was then found impossible to unload them, as there was no platform available, making it impossible for them to render any assistance and leaving the work of saving the city of Venice and the remainder of Ocean Park to the auto engine and the high pressure water system of Venice. The auto engine ran thru places that it would have been impossible to drive a team of horses, on account of the excessive heat and smoke and the flying sparks, and was moved from plug to plug as the water supply was exhausted in a remarkably short time, practically saving the remainder of the town and possibly the city of Venice. I believe that while this engine was on the ground it accomplished as much good as two steamers would have done, considering the time it took to move and that it was pumping first fresh and then salt water and experienced no trouble about fuel.

The gas engine has proven its worth in automobiles, electric plants, motor boats and holds an exclusive position of usefulness in aviation. Tho hundreds of gas engines are being produced by men who are not familiar with the elementary principles of them, they have demonstrated their worth to the entire satisfaction of all, and I can see no valid reason why they are not as reliable as steam engines, in fact, they are supplanting steam engines in nearly every line of industry, and I believe they have less chance of failure than the steamer with its many ailments, such as explosions, leaks, foaming, poor coal, etc.

A very commendable feature which interests all city officials and especially the chief is the cost of maintaining the department and the apparatus in particular, as this is where the economizing can be first seen. In my opinion I have demonstrated by actual figures that the automobile pumping engine will save its purchase price in three years.

Mayor Crump Now Back on the Job

"All a Memphian need do to make him appreciate Memphis is to go away from home and keep his eyes open."

This was Mayor Crump's declaration upon his return to Memphis, after spending a month with his family at Beach Haven, New Jersey.

"When a fellow goes to other cities and sees a lot of dilapidated buildings, poorly kept up streets, garbage and rubbish lying around everywhere, unpainted telephone poles, and a dozen and one oth-

MAYOR CRUMP, *of Memphis, Tenn., after a successful fishing expedition.*

er evidences of neglect, it makes him feel right glad he is living in a progressive city like Memphis," said the mayor. "I want to say right now that we do not suffer by comparison with any city in the country."

The accompanying snapshot bears out Mayor Crump's assertion that the fish were biting in New Jersey. The mayor is shown with two of his sons, Edward and Robert, en route home with a morning's catch.

PERSONAL

American Society of Municipal Improvements

The principal features of the Wilmington convention of the American Society of Municipal Improvements, held October 6 to 9, were the consummation of the amalgamation of the Association for Standardizing Paving Specifications with the older organization, the full discussion of specifications and adoption of such as had reached that stage, and the first report of the committee on standard forms for receiving bids and recording costs of municipal improvements.

In accordance with the terms proposed and recommended by committees of the two organizations, membership of cities in the A. S. M. I., with delegate representation at conventions is provided; a past president of the A. S. P. S. becomes chairman of the general committee on standard specifications and George W. Tillson, the consulting engineer of Brooklyn, N. Y., has accepted that appointment; also the members of committees of the one society become members of the corresponding subcommittees of the other, thus increasing the membership in these sub-committees of the A. S. M. I., beyond the three or four heretofore customary. The system of reports of sub-committees on the specifications to the general committee and of discussions of these reports by all interested at open meetings of the general committee and the sub-committees is continued. The discussions of the sewer and brick committee reports at the Wilmington convention demonstrated again their value as a time-saver as well as an outlet for the oratory of those having changes to propose of these preliminary discussions.

The sewer and sewage disposal problems occupied more of the time of the convention and its committee annex than any other subjects, and while the discussion was not completed and the report was not finally adopted, nearly all of the specifications were approved informally and can be used pending the final completion of the consideration.

The discussion on the brick question was nearly all in a special meeting of the committees called in the cabin on the boat during the trip on the bay, and centered about the method of selecting brick for test. The method proposed for the American Society for Testing Materials and described in Professor Edward Orton's paper before the society was not approved by the committee at large, and the selection method now provided for in the adopted specifications was allowed to stand. A committee was appointed to confer with the committee of the Society for Testing Materials, with a view to reaching an agreement upon this point, which is almost the only point of difference between the specifications of methods of testing brick of the two societies.

The election of officers resulted in moving the vice-presidents up one notch, E. H. Christ, of Grand Rapids, Mich., becoming president, and Norman S. Sprague, of Pittsburg, Pa., the last president of the A. S. P. S., being selected to fill the vacant third vice-presidency. A. Prescott Folwell, who has been the very efficient secretary of the association for the past six years, declined re-election and Charles Carroll Brown, 702 Wulsin Bldg., Indianapolis, Ind., was elected to fill his place. W. B. Howe, city engineer, Concord, N. H., is the new treasurer.

The exhibits at the convention were an important feature, which is each year making a better showing. The exhibitors included Charles Warner Co., Wilmington, Del.; Barrett Mfg. Co., Philadelphia, Pa.; Yellow Pine Manufacturers' Association, St. Louis, Mo.; Barber Asphalt Paving Co., Philadelphia, Pa.; Dunn Wire-Cut-Lug Brick Co., Conneaut, O.; Buff & Buff Mfg. Co., New York City; Union Clay Products Co., New Brunswick, N. J.; Good Roads Machinery Co., Kennett Square, Pa.; Robeson Process Co., Pennington, N. J.; Lock Joint Pipe Co., New York City; Warren-Knight Co., Philadelphia, Pa.; Coleman DuPont Road, Inc., Bureau of Inspection, Wilmington, Del.; National Water Main Cleaning Co., New York City;

Bausch & Lomb Optical Co., Rochester, N. Y.; U. S. Asphalt Refining Co., New York City; Addressograph Co., Chicago, Ill.; Electro Bleaching Gas Co., New York City; National Association of Paving Brick Manufacturers, Cleveland, O.; Warren Brothers Company, Boston, Mass.; Lehigh Portland Cement Co., Allentown, Pa.

The next convention will be held in Boston, Mass.

American Road Congress

The third American Road Congress, held in Detroit the week of October 1, registered 3,600, making it the largest meeting of its kind that has been held. The program as outlined in the September number of MUNICIPAL ENGINEERING was followed closely. The exhibit feature was as important as usual. The outside interest in the Wayne county concrete roads was intense largely because of the intention on the part of those interested in materials for making hard roads to make sure that visitors saw all the points favorable and unfavorable to the roads in question. The paving determinator under the conditions existing made very different showing from its former work and demonstrated, if the demonstration was necessary, that the machine and the conditions under which it works must be studied in great detail and thoroly standardized before its indications can be accepted as of any value. A number of new machines for road work were exhibited. The officers of the American Highway Association were re-elected, J. E. Pennybacker, Colorado Bldg., Washington, D. C., secretary.

The resolutions adopted by the congress favor a National Board of Public Works with its head a cabinet officer; state highway commissions and state aid for road construction and maintenance; a national road system with state, county and town laterals and connecting roads to markets; a commission to study and recommend a system of federal aid; official national representation at International Road Congress; investigation by the U. S. Office of Public Roads of applications for patents affecting road and bridge construction; both the Lincoln Highway and the National Old Trails Associations; compulsory use of wide tires and the road drag; use of convicts in road construction and maintenance; long tenure of office of efficient highway officials.

Technical Associations

The New York State Road Builders' Association is an organization three years old which is devoted to the benefit of highway contractors. Connecticut has a similar association. And now the New York organization proposes organizations of the same sort in all states in which highway improvements are under way, with an affiliation of the state organizations with each other for concerted action on matters of common interest. John J. Ryan, 25 N. Pearl St., Albany, N. Y., is secretary of the New York association.

An exhibition of American and foreign city planning will be held in New York City Nov. 24 to Dec. 6, 1913, under the direction of the Heights of Buildings Committee of the Board of Estimate and Apportionment of the city of New York. The exhibit will be arranged under 22 general heads and many sub-heads, including buildings of various classifications, fire protection, markets, legal restrictions, parks, streets, transportation, waste disposal, water supply, taxation, etc. Much of the exhibit will be available for use in other cities after this exhibition has closed and it will probably travel about the country as may be desired. Material for the exhibition may be sent to the American City Bureau, 93 Nassau St., New York.

The United States Good Roads Association will hold a convention and exposition in St. Louis, Mo., Nov. 10 to 15, 1913. J. H. Bankhead, Washington, D. C., U. S. Senator from Alabama, is president, and J. A. Rountree, Birmingham, Ala., is secretary.

A national conference on concrete road building, will be held at the Auditorium Hotel, Chicago, Feb. 12 to 14, 1914, under the auspices of an advisory committee of which Prof. W. F. M. Goss is chairman, and J. P. Beck, 72 W. Adams St., Chicago, Ill., is secretary. It will be held during the annual Chicago cement show. Other organizations which will meet during the progress of the show are the American Concrete Institute, Interstate Cement Tile Manufacturers' Association, National Association of Sand and Gravel Producers, Illinois Lumber and Builders' Supply Dealers' Association and the National Builders' Supply Association.

The tenth convention of the American Road Builders' Association will be held in Philadelphia, Pa., Dec. 9 to 12. There will be about five sessions devoted to papers and discussions, including a popular mass meeting, and an afternoon and an evening will be given to entertainment and an automobile inspection of the city. The usual exhibit of road materials and machinery will be held at the First Regiment Armory, where the sessions of the convention will also be held, and national, state and technical exhibits will be even more complete than at Cincinnati last year. E. L. Powers, secretary, 150 Nassau St., New York City.

Special freight rates on exhibits for the Panama-California Exposition to be held

at San Diego, Cal., during the entire year 1915 have been announced with free return of all but one or two classes.

The American Society of Engineer Draftsmen has become strong enough to begin the publication of a monthly journal, publishing papers delivered before the society, book notes, correspondence and an index of articles on drafting and allied subjects in current publications. Walter M. Smyth, 74 Cortlandt St., New York, is secretary.

The Panama-Pacific Exposition at San Francisco is now in the rush of construction and is up to schedule time which will finish the buildings nine months ahead of the opening time. The committee having the Engineering Congress in charge is now sending information regarding membership and the distribution of the proceedings which promise to be one of the most valuable collections of descriptions of engineering works of all sorts and reports of progress ever made.

The New York Electrical Society, founded in 1881, is now publishing its transactions regularly, six numbers having appeared in the past year. At its meeting held Oct. 23, L. A. Hawkins presented a paper on "The Place of America in Scientific Research Work." Geo. H. Guy, secretary, Engineering Societies Building.

The Merchants' Association of New York has established itself in its new offices in the Woolworth building and is now able to enlarge its valuable work in the advancement of the commercial and civic interests of the city.

The second annual fall meeting of the Vermont Society of Engineers was held in Burlington, Oct. 8. An interesting paper on hydrographic surveying, an inspection trip to dam, concrete arch bridge and hydro-electric plant under construction, the business of the society and a "round table" supper filed the day and evening. Geo. A. Reed, secretary.

At the meeting of the Municipal Engineers of the City of New York on Oct. 22, the work of the department of street cleaning was described by Fred L. Stearns the superintendent of final disposition of the department. On Oct. 17 the society visited the Bethlehem steel plant. Geo. A. Tabor, secretary.

The Indianapolis-Lafayette section of the American Institute of Electrical Engineers heard a paper by Lewis L. Tatum on industrial motor control at its first meeting of the year, held Oct. 10. G. B. Schley, secretary.

The Brooklyn Engineers' Club had a paper by Charles S. Doron at its October meeting on the shore road improvement made by the department of parks of Brooklyn.

The Colorado Association of Members of the American Society of Civil Engineers at its October meeting heard Leonard Lundgren, of the U. S. Forest Service, on the organization and conservation policy of that office, especially as to water and power development.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

Nov. 5-6—Aid in Bureau of Standards, Department of Commerce, at $600 to $720 a year.

Nov. 10—For various grades of Electrometallurgist, assistant metallurgist, metallurgical engineer, metallurgist, chief metallurgist at salaries of -1,800 to $4,800 a year; also assistant petroleum chemist at San Francisco or Pittsburg, at $1,800 to $2,160 a year; all in the Bureau of Mines, Department of the Interior.

Personals

Preparatory to the design and construction of a garbage disposal plant at Corpus Christi, Tex., Mayor Miller, Commissioners Uehlinger and Sutherland and City Engineer Stevens during the past month inspected similar plants at Houston and Galveston. This inspection has resulted in the acquisition of much practical information which will prove of value in the design of the Corpus Christi plant, upon which $20,000 will be spent.

Chief Engineer Hendrick, of the Baltimore Sewage Commission, recently reported to the commission that during the month of September over 3,400 men were employed on sewer construction work in that city. He estimates that on this basis over 17,000 people of the city are dependent upon the commission for their daily living. This fact gives some conception of the magnitude of the work Baltimore is now carrying on.

One of the latest developments in connection with the Chicago garbage disposal problem is the recent announcement by a committee composed of Chairman Nance, Col. Henry A. Allen, the city's engineering adviser, and Miss Mary McDowell, that a number of experts from over the country will be called into consultation to relate their experiences and knowledge upon this question. Among those already listed are A. Tuska, of New York, Supt. Osborne, of the Columbus, O., municipal plant, and Langdon Pearse, engineer for the Chicago sanitary district. Dr. J. M. Hirsh has presented a proposition to the commission in which he offers to pay the city ten cents a ton for all garbage delivered to him for reduction in a plant which he claims can be constructed within thirty days. His plan contemplates reduction

by a chemical process which has not yet been made public.

A recent decision by Chairman Compton of the Baltimore Paving Commission is expected to broaden competition on sheet-asphalt paving in that city and to prevent the cost of work of this character from soaring. It has been announced that hereafter bids will be considered from general contractors under the commission's specifications and the work awarded providing the contractor can assure the commission and board of awards that he is in a position to perform the work satisfactorily. Heretofore it has been practically impossible for five or six local contractors engaged in brick and granite block work to bid on asphalt paving. This move will probably place in full operation several asphalt plants which during the past have only been working two or three days in the week.

In a recent address before the Commercial Club of St. Cloud, Minn., Hiram A. Cool, paving expert of Minneapolis and Chicago stated that the maintenance of creosoted wood block pavements in Minneapolis to the extent of 1,920,..10 square yards the original cost of which had been $2,777,534 had for the past 11 years totaled $655.56 which amounts to a repair cost of two-hundredths of one per cent. In 1910 the repair cost on pavements laid two years prior was one-hundredth of one per cent., and in 1911 and 1912 it was six-hundredths of one per cent.

October first Governor McCreary of Kentucky issued a proclamation calling upon the people in every county in the state to work on the roads on two days, October twenty-fourth and fifth beginning at eight o'clock each day and continuing until five in the afternoon. The county judge and engineer in each county were authorized to organize and aid the people in every manner possible and to also select such persons as they needed to assist in the work. In counties not having highway engineers the sheriff was given the same authority and power as in counties having engineers. Governor McCreary appealed to the patriotism of the people of his state to do their utmost to place the dirt, gravel roads and turnpikes in the best possible conditions during the two days of work.

The city of Detroit was recently confronted with the problem of selling $1,000,000 worth of bonds for its educational fund to provide new schools. The rate of interest offered was 4 per cent., and owing to the inactivity of the bond market some trouble was encountered in effecting sales. Henry Ford was approached with a view to selling to him a portion of the issue. In the course of a short interview Ford announced that he would take the entire issue at par. Inasmuch as the city had anticipated that it would be necessary to place the bonds on the market on a 4½ per cent. basis, the sale as finally consumated will mean a saving of $150,000 over a period of 30 years. In another light this may be considered as a donation to the city.

Technical Schools

Dr. Earle B. Phelps, of the biological department of the Massachusetts Institute of Technology has resigned to enter the U. S. Public Health Service in his specialty of chemical biology. Robert Spurr Weston has been appointed assistant professor of public health engineering and while not assuming the same work will fill the vacancy in the faculty. Mr. Weston graduated from the Institute 20 years ago and has been a successful consulting sanitary engineer for about 15 years, after large opportunities in study at home and abroad and experience in engineering construction.

Harvard University and the Massachusetts Institute of Technology begin this fall in co-operation a school for public health officers, which will have access to the facilities of both institutions and give a certificate of public health (C. P. H.) signed by presidents of both. It is a post-graduate course for college students, a medical degree not being necessary, tho desirable, for admission. Prof. M. J. Rosenan, of Harvard, is the director of the school.

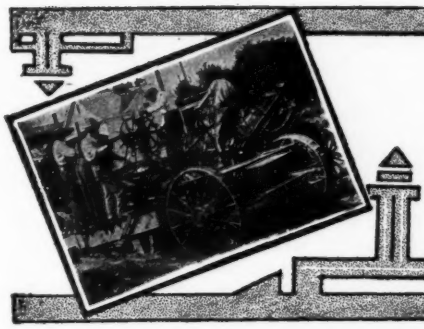
New Publications

A new magazine is entitled *The Efficient Citizen* seems to be devoted to the work of the business booster, the city development promoter, the commercial organizations which can do so much for the uplift and advancement of their communities. It is published in New York and is a monthly.

Concrete Roads and Pavements. By E. S. Hanson, affiliate member of Western Society of Engineers, Editor *The Cement Era*, Chicago, Ill. Cloth, 227 pp.

Annual report of the Department of Public Works of Cincinnati, O. Paper, 118 pp. Victor T. Price, director of public service; Henry M. Waite, city engineer.

Wright on Quantities, a plea for a better system of estimating cost of buildings in the United States, 16 pp., 50 cents; Wright on Building Arbitrations; a manual for architects, students, contractors and construction engineers, 46 pp., $1. By G. Alexander Wright, M. San Francisco Chapter A. I. A., M. Tech. Soc. of Pac. Coast. 571 California street, San Francisco, Cal.



MACHINERY AND SUPPLIES

Pavement Doubly Reinforced

Both top and bottom of the concrete pavement laid in Parkview avenue, Detroit, Mich., in October, 1912, were reinforced with a mat of round bars fabricated on a wooden frame having the exact slopes of the finished street. Stools made of 3/16 by 1 by 1-inch angles support the rods exactly in place and tie the top and bottom bars together. While this street is in a residential district it leads from Jefferson avenue to the water and sewage pumping stations, to which there is more or less heavy teaming. Formerly this 28-foot street was paved with cedar blocks, of which very little remained. The concrete pavement is 6½ inches thick, laid on what was left of the old macadam base. There is a 4-inch bottom course of 1:1½:2 mixture, over which there was laid 2½ inches of finish composed of 1 part cement to 2 parts crushed granite chips.

Both ways the ¼-inch bars on top are spaced on 2-foot centers, while the ⅜-inch bars on the bottom are 4 feet apart. The bars are threaded thru the punched openings in the stool, which raise the lower bars 1¼ inches from the base and space the top bars 1¾ inches from the top of the pavement. Rigidity of the mat is secured by closing onto the bars the punched metal strip below the hole for the bars with a special tool.

Every 30 feet there are expansion joints consisting of 3/16 by 3-inch steel strips secured to the concrete by S-shaped bars, one end of which is hooked over a reinforcing bar and the other inserted in a loop punched from the steel strip. A space of ½-inch between adjacent slabs is filled with asphalt.

Several miles of concrete pavement in and near Detroit have been reinforced by this method, which is controlled by the Thomas Steel Reinforcement Company, of Detroit, Mich. It is the claim of the company that the bottom reinforcement, which is less than that on top, will care for all cracks that might be caused by the irregular motion of the mass of concrete due to the friction between the uneven surface of the sub-grade and the slabs, especially under the influences of arch action or the entrance of water under the pavement which, in freezing, would produce an upward pressure at the sides causing cracks near the slab center. The top bars are placed to care for shrinkage and temperature stresses as well as cantilever stresses induced when heavy loads pass over the soft spot in the subgrade near the edges of the slabs.

Creosoted Wood Block Pavement in Duluth

By John Wilson, City Engineer, Duluth, Minn.

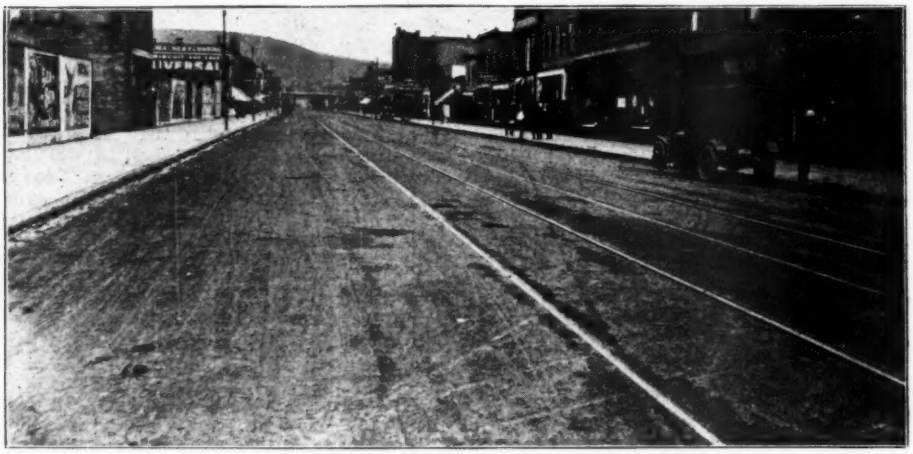
Our system requires the city to pay about 10 per cent. more for paving an avenue than it does for paving a street; and it pays a larger per centage for paving a narrow street in the residence district than it does for a wider street in the central portion of the city, where the public benefit is greater. The proportion of cost borne by the property and by the city should be determined along scientific lines, and not by an arbitrary rule, which is an outgrowth of arbitrary methods sometimes used in making assessments. A pavement that is laid for public benefit should not be paid for simply because one happens to live in a vicinity; nor should the city pay for a pavement that is being laid solely for the benefit of adjoining property. Then, too, some consideration should be given to the question of use, life, repairs, maintenance, etc. At present the economic interests of the abutting property owners and that of the city are not the same, in fact they are actually antagonistic. The less the first cost the better for the property, the less the cost of repairs the better for the city; and as a rule pavements of low first cost are not cheaply repaired or maintained.

We have had no up-keep or maintenance cost on the 15,940 square yards of long leaf yellow pine wood block paving laid on First street in 1905. In 1912, 9,568 square yards of the same pavement

were laid on Central avenue, and there is every reason to believe that the first cost of this pavement will also be the only cost. While our experience with creosoted wood block paving has been limited, it has nevertheless been sufficient to cause serious thought. The people's money should be expended for laying more pavement, not for relaying old pavements. Any sheet surface construction of pavement is a constant drain on the city after it has been laid a very few years, and the repairs are very expensive. If the creosoted wood block pavement was as well exploited and as powerfully

ments consisted of a 3½-inch block laid on a 1-inch sand cushion and a 5-inch concrete base. Bids were received on both oils, according to the New Orleans specifications, 16-pound treatment. The bids for the heavier oil being about 10 per cent. less than that for the lighter, the contract was let for the heavier, as we did not believe our present knowledge of the comparative values of the two oils would justify the difference in cost. An asphaltic filler was used instead of pitch and no complaints of any kind can be made because of bleeding.

Between the street car tracks we used



CREOSOTED YELLOW *pine street, Duluth, Minn. On 15,940 square yards laid in 1904 to date there has been no up-keep or maintenance attached to this kind of pavement.*

promoted thruout the United States as are many inferior forms of pavements which disgrace many of our city streets, there would be little else but wood block paving laid in the United States.

The first creosoted wood block pavement in Duluth was laid in 1905. The form of construction was rather unfortunate, and has given rise to considerable unjust criticism of the pavement. The curb on one side of the street is much lower than that on the other, which, together with rather an excessive crown, gives the pavement an exceedingly steep cross grade, which results in quite a slippery pavement. The pavement was also laid with a 2-inch sand cushion beneath the wood block; and this sand has shifted badly, leaving the surface uneven. The repairs on this pavement have been practically nothing, and aside from the objection above mentioned it is still in good condition. We have not been troubled with either bulging or bleeding. Any other pavement subjected to such treatment would be in a sorry state today.

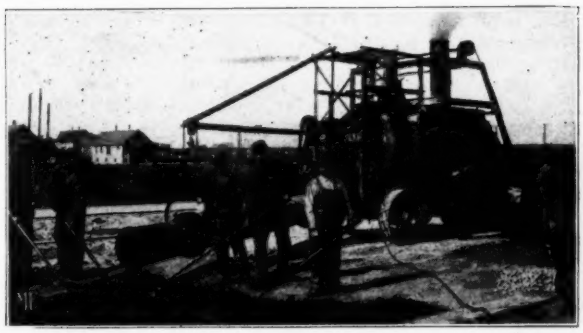
Last year our creosoted block pave-

a 4-inch block. The rails are 7-inch T-rails, and a flange way was provided by cutting the block on a bevel of 1½ inches deep and 6 inches long. The outside block was cut with a square notch so that the ends of the blocks fit up to the web of the rail and the top was ¼ inch below the top of the rail. Along the tracks we used a ½-inch mortar cushion, 1 part cement and 4 parts sand, instead of the 1-inch sand cushion. So far this form of construction has proved very satisfactory. The pavement is almost noiseless, easily cleaned and very easily repaired.

Some four or five years ago the United States government laid as an experiment, on a street in Minneapolis, a wood pavement made up of a great many different kinds of wood, all treated with 1.09 creosote oil, the idea being to ascertain the relative merits of these different kinds so that a selection of material could be made according to the traffic on any particular street or the availability of any material. The kinds of wood used were long leaf pine, Norway pine, tamarack, Douglas fir, western larch, white birch

and hemlock. The long leaf pine was used to serve as a standard of comparison. The conclusion was reached after the examination of the pavement, four years after it was laid, was that the species used will be tentatively grouped in accordance with the result of this inspection in order of their value for creosote oil paving materials as follows: (1) Long leaf pine; (2) Norway pine, white birch, tamarack, Eastern hemlock; (3) Western larch; (4) Douglas fir.

In the East, as a matter of fact, the long leaf yellow pine block has been used almost entirely up to the present time, the principal exception being black gum. This, however, has not given entirely satisfactory results. Yellow pine stands up exceedingly well under end compression.



MIXING *and depositing Westrumite pavement with Chicago concrete mixer.*

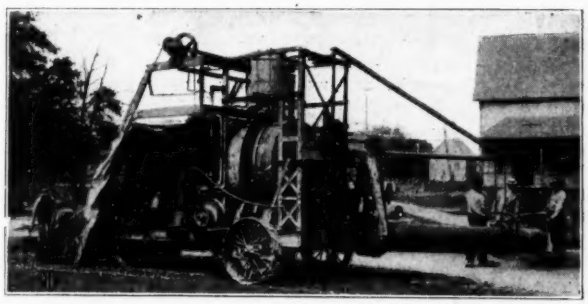
Laying Westrumite Pavements with a Chicago Concrete Mixer

The following article gives a description of the cold method construction of asphaltic pavements in use in many cities. The asphaltic cement is known as Westrumite, and is manufactured by The Westrumite Company at Whiting, Indiana, and by other companies at Washington, D. C.; Portland, Oregon; Brantford, Ontario; Antwerp, Belgium, and Vienna, Austria.

The photographs illustrate the use of the Chicago concrete mixer made by the Chicago Concrete Machinery Company, Milwaukee, Wisconsin, in the construction of Westrumite pavements by Nejdl & Greenwald, contractors, at Whiting, Indiana. The mixer is used both in laying a concrete base and the 2-inch Westrumite wearing surface. The efficient charging device and the revolving tube spout with which it is equipped greatly facilitate the handling and spreading of the material, and reduce the labor cost to a minimum.

Westrumite is a highly efficient asphaltic cement manufactured at present from Trinidad Lake asphalt blended with a special California asphalt, and placed in a temporarily liquid condition by emulsification under the supervision of expert chemists at the factory. It is shipped to the job in barrels, and without any heating or further preparation is mixed cold with the required mineral matter in any concrete mixer. It is then spread on the foundation and after a certain amount of setting, is compressed into a very durable and pleasing surface.

The peculiarity of construction involved, being a combination of the mixing and penetration processes, is adaptable only to a liquified asphaltic cement. The body of the pavement is a coarse hard stone all of which passes the 2-inch ring and is retained on the 1½-inch ring, the use of which gives greater durability and better wearing qualities. This stone is coated in the mixer with a sufficient amount of Westrumite to thoroly cover all the surfaces, and is then spread on the foundation as shown in the first photo. Very little raking is required with the use of a Chicago mixer since the tube spout deposits the material from one side of the street to the other, wherever required. After spreading this coated stone for a distance of about 20 feet, the mixer is run back and spreads the mortar coat over the coarse stone which has not been compacted—merely raked level. This mortar is a mixture of stone screenings, the grading of which is similar to the grading of the stone as required in the Topeka specifications for asphaltic con-



MIXING *and placing mortar coat as wearing surface of Westrumite pavement. Chicago mixer in foreground.*

crete, and sufficient Westrumite to give the proper amount of bitumen. The consistency of this mortar as it is spread on the coarse stone is just at the point of saturation. This very fluid condition causes it to penetrate into every void between the coarse stone. With the evaporation of the vehicle, the asphaltic cement solidifies, and after a thoro rolling during the process of setting, the result is a 2-inch wearing surface which is a dense, compact mixture of hard stone and the very best asphaltic cement. A flushing coat put on by hand with street brooms puts a finishing touch to this unique, yet satisfactory method of construction of asphaltic pavements.

The fact that Westrumite is liquified by emulsification and not by heat allows it to be mixed cold and eliminates the necessity of heating the stone and having it perfectly dry. The asphaltic cement which must be heated to make it liquid, will congeal when it comes in contact with moisture, and would not remain sufficiently liquid to penetrate into the voids of the coarse stone used in this construction. Neither would it penetrate a film of dust that may be coating the stone. The liquified asphaltic cement will, and adheres to the stone, not to the film of dust. Furthermore, the evaporation of the vehicle allows sufficient time to thoroly roll and compact Westrumite asphaltic pavements before solidification.

The elimination of expensive heating machinery and dangers of overheating asphalt; the lowering of labor cost; and the comparative ease of handling and making repairs are features which are making this material more popular every year, and causing this pavement to be adopted all over the country.

With the use of the Chicago concrete mixer in the construction of Westrumite pavements, working steadily thru a ten-hour day, about 1,000 square yards of the 2-inch wearing surface are completed. The same number of men are required to man the mixer for the Westrumite top as for the concrete base. The labor cost is much lower than for any other type of asphaltic pavements. The cost of the pavement complete on a 6-inch concrete base has ranged from $1.80 to $1.90 per square yard in several cities of Lake county, Indiana. Where a broken-stone foundation has been required by cities, the cost of the pavement complete has been about an average of $1.65 per square yard.

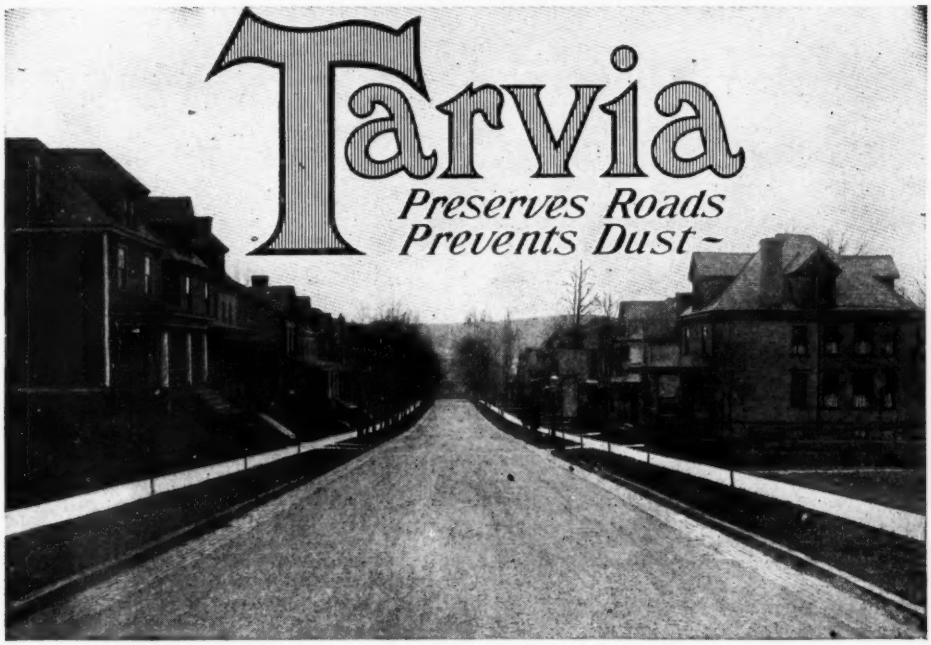
Pavement of Buena Vista Avenue, Highland Park, Mich.

By Carl T. Jerome, C. E.

Since it is known that pavements will increase and decrease in length under average conditions, it is advisable to make use of expansion joints across the pavement at certain definite intervals, and these joints should be of sufficient width to allow for the maximum expansion. Since concrete during the time of setting will contract an amount equal to that due to the change in temperature of approximately 100 degrees, it has been argued by some engineers that contraction joints are of more importance than expansion joints. By contraction joints is meant a cutting thru of the entire pavement, or in other words, simply a line of separation of adjacent sections. This may be produced by either using a very thin sheet of steel or by the construction of alternate sections of the pavement. It is, however, in our opinion, unnecessary and in fact, not advisable to make use of contraction joints, for the reason that, assuming that the pavement is constructed during the warmer portions of the year and that the contraction cracks will open up due to the settling of the concrete or to a decrease in temperature or both, these cracks under traffic will become filled with dust and grit to such an extent as to prevent the pavement from expanding when the temperature again rises. We believe, therefore, that expansion joints properly filled with an elastic material should be used to the exclusion of contraction joints, altho it may be safely stated that an expansion joint is also a contraction joint when properly filled and protected at the edges.

A most successful example of concrete pavement with expansion joints properly protected with Trus-Con armor plates is on Buena Vista avenue, Highland Park, Mich. On this job two plates were clamped together with a board of desired thickness between, cutting the entire depth of the pavement. After concrete is poured this board is removed and the space filled with plastic asphaltum. If preferred, a layer of asphaltum felt of desired thickness can be used between the two plates. Either process is satisfactory, will allow the expansion and prevent joint filling with grit; altho the felt method is somewhat cheaper. The assembled plates are held in place at exact grade line by pins driven into subgrade, which are withdrawn after concrete has set.

This pavement was also reinforced with rib-metal, a bar reinforcement, consisting of a series of nine straight bars, or ribs, rigidly connected by cross-ties formed from the same section of steel. The cross-ties accurately space and thoroly anchor the main bar in the concrete, providing a perfect cross-reinforcement against temperature and shrinkage strains. Rib-metal is shipped in flat sheets and there is no unrolling of coils,



Monitor Avenue, Ben Avon, Pa. Constructed with "Tarvia X."

Tarvia in Ben Avon

A FEW years ago Ben Avon, Pa., was still building old-fashioned water-bound macadam roads.

Then the automobiles came and so did the dust.

Something had to be done to prevent disintegration of the road surfaces. The local authorities began experimenting with "Tarvia A" and obtained excellent results.

In 1909 Watt Avenue was constructed with "Tarvia X" and is to-day in perfect condition. The Borough now paves all of its new streets with "Tarvia X" and uses "Tarvia A" for the maintenance of its old macadam surfaces.

A steady policy has been pursued of using "Tarvia A" as fast as possible on the old water-bound surfaces with a result that a large part of the road area in Ben Avon is now in excellent shape.

Mr. C. D. Dyer, President of the Borough Council, states:

> "I cannot express too strongly my recommendation of Barrett products for finishing streets for the use to which they are devoted in a Borough like Ben Avon."

Tarvia is a special coal tar compound which is used as a binder to form a tough, plastic, waterproof matrix around the stone in a macadam road, preventing attrition by automobile traffic and erosion by water.

There are three grades of Tarvia:—"Tarvia X" for road and pavement construction and resurfacing; "Tarvia A" for road maintenance; and "Tarvia B" for dust suppression and road preservation.

Booklets free on request. Address our nearest office.

BARRETT MANUFACTURING COMPANY

TRADE B MARK

New York Chicago Philadelphia Boston St. Louis Kansas City Cleveland Cincinnati Minneapolis Pittsburgh Seattle Birmingham

The Paterson Mfg. Co., Ltd.—Montreal Toronto, Winnipeg, Vancouver. St. John, Halifax, Sydney, N. S.

BUENA VISTA AVE., *Highland Park, Mich. Construction of concrete pavement, showing pavement reinforcement being placed, and expansion joint which extends entire depth of pavement.*

cutting to lengths or special labor to hold the steel in place.

Both the armor plate and reinforcing metal as used on this piece of construction were furnished by the Trussed Concrete Steel Company, of Detroit, Mich.

Marble Rock, Iowa, Park Bridge

By Miller Hey Construction Company, Waterloo, Iowa.

The Park Bridge, Marble Rock, Iowa, was designed and constructed by us in 1912 in order to facilitate travel over a ravine between the town of Marble Rock and its city park. The length of the bridge is 97 feet, 4 inches, clear roadway 20 feet, with a 5-foot sidewalk on one side, and the grade line is about 20 feet above the creek bed. Ordinary reinforced deck-girder construction was used; and in order to make a more artistic appearance, curtain walls, 8 inches thick, elliptical in shape, were attached to and concreted with the outside girders. The contract price of this bridge was $3,350.00, and it was completed in fifty days.

The concrete was made from a high grade portland cement and a very good grade of bank gravel, in the proportion of 1:4½ for the girders, floor, coping, columns, and curtains; and 1:6 mixture for the abutments. Screened sand of 1:2½ mixture was used for the hand railing.

For the reinforcing, square twisted bars were used, having an elastic limit of 40,000 pounds per square inch. The concrete was mixed in the above proportions with a Standard low charging mixer as furnished us by the Standard Scale & Supply Company, of Chicago.

The foundations for this work were carried to rock, which was only a few feet below the surface of the ground at the site.

Considerable misapprehension exists as to the strength of gravel concrete in such structures. To secure the necessary strength in gravel concrete, the cement is proportioned in accordance with the amount of sand contained in the gravel; sand being defined as that part of the gravel which will pass thru a ½-inch screen. The only requirement as to relative proportions of sand and stone in the gravel is that the volume of sand must not fall below 0.6 of the volume of stone. Any gravel, therefore, having a sand to stone ratio greater than 0.6 may be used without modification, but for gravel so used the cement ratio must be constant for a given class of concrete. It is necessary, however, to watch the grading of the sand content of the gravel to see that there is a sufficient proportion of the finer particles, that is, those below 1/16 inch. Tho usually gravel sand contains an excess of finer particles, there has been encountered occasionally a gravel that lacked a sufficient amount of the smaller grains to make a good mortar.

The use of practically all gravels composed of satisfactory material is usually possible under the above provisions. The resulting proportions stated in the usual form may vary for a certain class of concrete, from 1 part cement to 2½ parts sand and 4 parts stone to a mortar mixture of 1 part cement to 2½ parts sand.

This method of proportioning is based on the assumption that if the sand and stone are of satisfactory quality, and the ratio of sand to stone is equal to, or great-

SOUTHERN YELLOW PINE

THE BEST WOOD FOR CREOSOTED PAVING BLOCKS

OWING TO ITS EXTRAORDINARY PHYSICAL CHARACTERISTICS.

Close Annular Rings, Dense, Hard, Strong and Durable.

Mr. H. W. Durham, Chief Engineer in Charge of Highways, Borough of Manhattan, City of New York, states:

> "Our specifications provide that the wood to be used shall be ***Southern Long Leaf Yellow Pine.*** * * * That the popularity of 'Creosoted Wood Blocks' as a paving material is illustrated by its present use—320,000 square yards having been awarded in the City of New York during 1912. * * * Very little trouble and few repairs has resulted when the material has been ***Yellow Pine,*** and the absorption test has been maintained."

The facts are, *Southern Yellow Pine* has made "Creosoted Blocks" a popular paving material, owing to its *great strength under end compression, dense, hard texture, and uniform straight grain.* The resin this wood contains is a preservation in itself, so that Yellow Pine blocks, when properly creosoted, will insure absolute paving satisfaction for *years* in the most trying, congested traffic districts of our largest cities, namely, New York, Boston, Chicago, St. Louis, Atlanta, Cincinnati, Detroit, Louisville, Memphis, etc.

Mr. ENGINEER: Hereafter be explicit. ***Specify*** "Southern Yellow Pine" for your next creosoted paving block contract. It makes an ***economical*** and ***desirable street pavement from every standpoint*** and gives ***longer*** and ***more efficient service*** for the money expended than any other pavement known to engineers.

No royalties paid for its use, and no large repair appropriations necessary.

WRITE FOR LITERATURE AND INFORMATION.

Yellow Pine Manufacturers' Association, 711 Wright Building ST. LOUIS, MO.

PARK BRIDGE, *Marble Park, Iowa, built by Miller Hey Construction Co., Waterloo, Ia., in 1912.*

er than 0.6, the strength of the concrete will be satisfactory, providing the ratio of cement to sand, or in other words the mortar, is always maintained constant for a given class of concrete.

Reinforced Concrete Pavements in St. Johns, Michigan

By E. G. Hulse, City Engineer.

In 1910, we laid our first concrete pavement of about 1,200 square yards, which was placed on just one city block on Spring street. This pavement was 36 feet in width and was laid with joints every 25 feet filled with paving pitch. Longitudinal joints are placed along each curb and are also filled with pitch. The pavement is 7 inches thick in two courses. The bottom 5-inch course is of 1 part cement to 6 parts of pit-run gravel, screening out stones larger than 2½ inches. The top course is 2 inches thick, 1 part cement, 2 parts sand and 3 parts crushed cobbles passing thru a ¾-inch mesh. The pavement surface was covered with tarvia. The cost of laying this pavement was $1.333 per yard. This includes the following items: Excavation, $100; tarvia cost $60.65; curb, $181.47; expansion joints, $20.52; catch basins, $75.00.

Our specifications provide for the use of Baker armor plate for expansion joint and mesh reinforcement. These expansion joints are placed at intervals of 20 to 30 feet extending from curb to curb. Wherever the pavement comes in contact with street car or other tracks, expansion joints are made at the end of the ties in order to provide for vibration caused by the jar of passing cars. These expansion joints are armored and their edges are protected against abrasion by means of 3/16-inch soft steel plates 2½ inches wide which are provided with shear members. These shear members tie the plates securely to the concrete base and wearing surface.

In the year of 1912, we laid approximately 15,000 square yards of reinforced concrete pavement consisting of a base 5 inches thick mixed to the proportion of 1 part of portland cement to 7 parts of gravel including sand. The top wearing surface is 2 inches thick, mixed in the proportion of 1 part portland cement to 3 parts of clean sharp sand. Triangle mesh reinforcement style No. 29 was used as a reinforcement, the same being placed between the base and the wearing courses. Expansion joints were so constructed along the curbs and across the street every 30 feet, all joints being protected with the Baker armor plate, which consists of a flat piece of steel about 3/16-inch thick and 2½ inches wide, bent to conform to the shape of the finished pavement. Two plates are used in each joint and are separated from ¼ to ⅜ inch. They are held in place by means of shear members which occur about 12 inches apart and are bent back at right angles to the plate and extended into the concrete. This pavement was designed by the writer, the contractor being James A. McKay, of Clare, Mich.

Vitrified Sewer Pipe Tests

Following are the results of tests as conducted by the Bureau of Sewers, Borough of Brooklyn, City of New York, upon a quantity of vitrified sewer pipe, varying in diameter from 24 inches to 42 inches. The manner of carrying out these tests is very similar to the method described by Dr. Gary and commonly known as the German method. The pipe was manufactured by the Blackmer & Post Pipe Company, of St. Louis, Mo., and was tested as called for in Brooklyn's specifications, as follows:

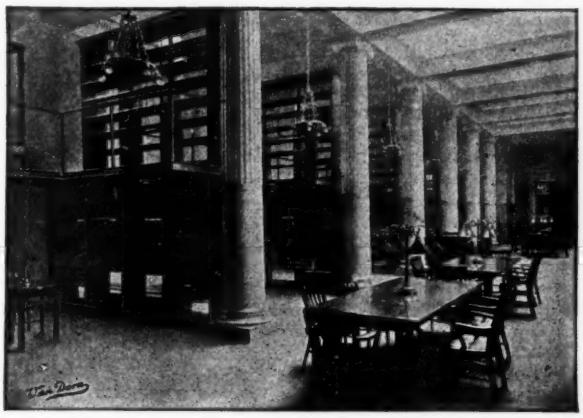
External crushing test. When supported upon a bed of thoroly compacted sand of such dimensions and in such manner that an even bearing is provided thruout the whole length, but without appreciable displacement of sand at the sides the various sizes of pipe shall withstand the following pressures applied at the crown uniformly along a line 1 inch in width and extending the whole length of the pipe exclusive of the bell.

V=A=N=D=O=R=N

METAL OFFICE FURNITURE

For Public Buildings, Court Houses, City Halls and Post Offices

Insures Real Protection Against Fires, Thieves, Meddlers and Carelessness



Simplifies and Keeps your Systems Uniform which means Highest Efficiency and Greatest Economy

Enclosed Type Library Shelves and Mezzanine Floor, Law Library, Shelby County, Memphis, Tenn.
Jas. Gamble Rogers (of Hale & Rogers, Architects).

Let Us Show You that it Will Pay

——To Have Your New Equipment
——"BUILT TO YOUR SPECIFICATIONS"
——Without the Extra Cost.

The unique and structural designs afforded by Van Dorn patents insure the widest range of choice and the greatest degree of elasticity at the smallest cost—our engineers will be pleased to help you plan your systems according to your desires and suggestions.

Located in the heart of the iron and steel manufacturing district of the United States, we get the very best materials at low cost, and we employ only first-class mechanics, case-makers and finishers. We have a factory and equipment devoted exclusively to the manufacture of steel office furniture, in charge of men who have been with us since the beginning of the metal furniture industry, who in fact have grown with the business and made it what it is.

CATALOG "M" ON REQUEST.

THE VAN DORN IRON WORKS COMPANY

METALLIC FURNITURE DEPARTMENT

General Office, CLEVELAND, OHIO.

Diameter.	Pressure per Lin. Ft.
6 inches	1,000 lbs.
8 inches	1,000 lbs.
9 inches	1,050 lbs.
10 inches	1,100 lbs.
12 inches	1,150 lbs.
15 inches	1,300 lbs.
18 inches	1,450 lbs.
20 inches	1,600 lbs.
22 inches	1,800 lbs.
24 inches	2,000 lbs.
30 inches	2,700 lbs.
36 inches	3,300 lbs.
42 inches	3,800 lbs.

"These tests," states Mr. Edwin J. Fort, Chief Engineer of Sewers, "were all made with a knife edge placed parallel to the axis of the pipe. As to what the crushing strength of this pipe would have been had the pressure been applied equally to the upper half of the pipe, the lower half being imbedded in sand, I will state that I have worked out the information in accordance with a complete analysis of this and similar problems made by me while a student at Cornell University and later by Prof. Talbot of the University of Illinois.

The following formulae were used in making the calculations, the knife edge load assumed as a concentrated load along the crown of the pipe:

e and f=Extremities of vertical axis.
g and h=Extremities of horizontal axis.
p=concentrated load per foot of length.
d=distributed load per square foot of diametral projection.
a=mean diameter of pipe from neutral axis of walls.
M=bending moment.

Formulae.

Bending moment for concentrated load.
Me=Mf=.16 pd.
(By Me, Mf, Mg, etc., is meant bending moment at e, f, g, etc.)
Mg=Mh=.09 pd.
Bending moment for distributed load:
Me=Mf=Mg=Mh
=1/16 pa^2.

The following table gives the results obtained:

A=Nominal diameter in inches.
B=Average wall thickness in inches.
C=Failed at in. pounds per linear foot under knife edge test.
D=Bending moment at e.
E=Height of column of earth weighing 100 lbs. per cu. ft. carried on pipe to give same bending moment for distributed load as given in column C.
F=Same as Col. E, earth weighing 125 lbs. per cu. ft.
G=Total load distributed per linear foot of pipe to produce moment in Col. D.

Columns E and F, showing the depth of the column of earth, weighing respectively 100 and 125 pounds per cubic foot, which the speciemns tested would have supported, do not provide for any lateral support , which the pipe always receives from the earth which is rammed about it when it is laid, but which is very uncertain in amount. No allowance has been made also for the arching effect of earth in the trench, which nearly always takes place, but which is also uncertain in amount. The most extreme case which could happen is considered, that is, the earth in the trench is of such a character that its whole weight is transmitted to the pipe and no lateral support is received.

Hundreds of miles of vitrified sewer pipes of all sizes have been laid in Brooklyn, under all kinds of conditions, with the most satisfactory results.

After careful observations made of the vitrified clay sewer pipe in a number of European cities, Mr. Fort is positive that double strength pipe, such as is manufactured by a number of the largest companies in this country, is of a high degree of excellence, and is not inferior to the best pipe of this kind that is produced anywhere.

Mixing of Concrete

By Creosoted Wood Block Paving Company, Dallas, Texas.

The mixing of concrete should be done as rapidly as possible and it should not be mixed in larger quantities than is re-

A	B	C	D	E	F	G
24-inch Std.	1 9/16	2420	825	28.50	22.5	6424
24-inch D.S.	2 1/16	3150	1090	36.5	29.0	8642
27-inch Std.	2¼	3875	1531	40	32	10670
27-inch D.S.	2 9/16	5183	2090	53	42	14340
30-inch Std.	2 7/16	4767	2081	45	35.5	13110
30-inch D.S.	2¾	4167	1890	38.5	31.0	11550
33-inch Std.	2 9/16	4433	2102	38.5	30.5	12170
33-inch D.S.	3	5658	2692	47.5	38	15680
36-inch Std.	2 9/16	4483	2320	35.5	28.5	12240
36-inch D.S.	2¾	5516	2868	43.5	35	15070
42-inch D.S.	3½	4967	3071	33	26.5	13683

SARCOLITHIC MINERAL RUBBER

THE IDEAL PAVEMENT

IT IS ALWAYS DURABLE
NOISELESS – SANITARY – ECONOMICAL
WATERPROOF AND DUSTLESS
INVESTIGATION INVITED

SARCO

Standard Asphalt and Rubber Co.
137 So. La Salle St. CHICAGO.

Sarcolithic Mineral Rubber Pavement, Springfield, Mo.

quired for immediate use. We have made it a point to exercise great care in the mixing of concrete and see that it is thoroughly mixed and not permitted to appear raw when deposited in the forms. The materials should be mixed wet enough to produce a cement of such a consistency as will flow into the forms and about the metal reinforcing, when used, and which, on the other hand, can be conveyed from the mixer to the forms without separation of the coarse aggregate from the mortar. In other words, the consistency of the concrete should be soft and wet without being sloppy, and in general should be such that after dumping the concrete into the forms it may be consolidated and worked into place with spades and shovels and a slight quaking secured with little or no effort. A good concrete worker can tell whether the concrete permits of easy tamping. The mixture should be moderately wet. Care, however, must be taken that the concrete is not too wet, so that the stone and sand settle under the water during its transfer to the forms, altho what is usually known as the wet mixture should be used for all reinforcement work.

"BIG-AN-LITLE" *concrete mixer in use at Dallas, Tex., for construction of concrete curbs and gutters.*

For ordinary work, concrete should be mixed wet, soupy. From the standpoints of quality, ease of handling and manipulation, resulting finish, and the cost of surfacing there is absolutely no question as to this point. This choice of wet concrete applies to walls, bridges, reinforced buildings, etc., but for sidewalk and pavements economy demands a dry mixture requiring tamping, in order that the workmen applying the finishing may follow as quickly as possible after the depositing of the concrete.

No concrete should be placed until it is definitely determined that the forms are correct and properly braced. It is cheaper to delay the work than to cut out work already done. Concrete should be placed as quickly as possible after mixing and not be disturbed thereafter. The placing of concrete is one point where the material is abused to the greatest extent. We take great care of a green brick wall but do not hesitate to walk over and conduct operations over concrete which has not reached its final set, thereby destroying the surface of the concrete for all time.

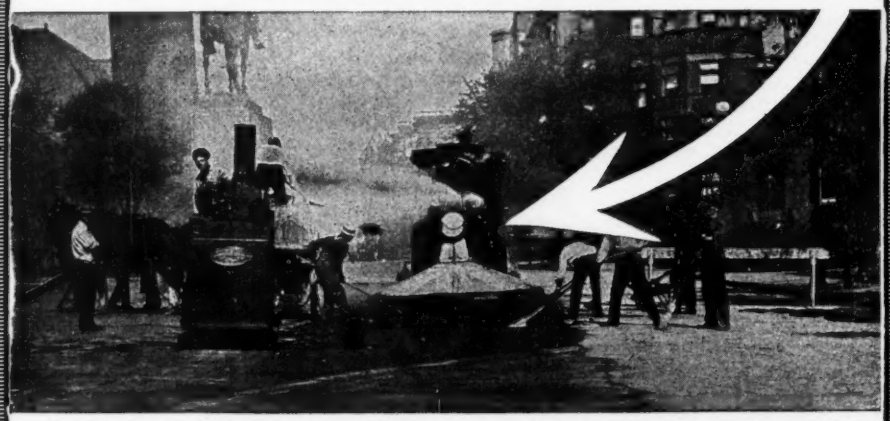
Various types of work naturally demand various types of machinery and arrangement, but in general it may be said that too large a mixer is not economical. Use preferably nothing smaller than 4½ cubic foot mixer, which will deliver up to 50 yards of mixed concrete per day. Only use a larger mixer than this if work will justify it. Also, in general, it may be stated that each batch from the mixer should be handled as a whole as nearly as possible to the place of deposit. The wheelbarrow is no longer the primary method of transportation of concrete. There is no doubt as to majority of opinion being in favor of batch mixers, but whatever type is adopted, it would be well in the long run to make sure that the engine is of sufficient power to handle real work with ease.

We use a 4½-cubic foot per batch mixer wherever possible, having found that this size machine is easily moved by its crew from and to different parts of the work during its construction. A number of batch mixers of this size could be more profitably employed on large work than a machine of greater capacity.

In our concrete curb and gutter work, we easily average 450 lineal feet of 30 cubic yards per day with a crew of five feeders and three wheelers. We shovel direct into the mixer, but later on will add to our mixer the automatic loader, which will increase its capacity nearly 50 per cent. The average time consumed in producing each batch is 2½ minutes, most of which time is at present taken up with the loading. Before the adoption of machine mixing, we secured very uniform results by the hand method but at a considerably greater cost. Our mixers are of the 'Big-an-Litle' type and were furnished us by The Jaeger Machinery Company, of Columbus, Ohio.

LUTZ SURFACE HEATER

(It discounts ordinary cost bills 48%)



Resurfacing asphalt pavement on Bedford Avenue, Borough of Brooklyn, New York. Work done by Lutz Surface Heater operated by Municipal Asphalt Plant, City of New York.

H. H. SCHMIDT, (Chief Engineer Borough of Brooklyn, City of New York)
STATES:

"We operate four Lutz Surface Heaters—the resurfacing of asphalt pavements which, through age and wear and tear are beyond ordinary repair, can be most economically done with these machines."

The LUTZ SURFACE HEATER

softens asphalt and other bituminous pavements. It vulcanizes the old and new material into a perfect weld. It cements asphalt on granite, brick, cobble or other hard pavements. It makes resurfacing and maintenance easy and inexpensive.

Equitable Asphalt Maintenance Co.

Commerce Building. **Kansas City, Mo.**

Illustrated particulars on request.

Nearly all cities have condemned the use of all machines forcing the flame upon the pavement because of the destructive effect of intense heat, and the **Lutz** *method should not be confounded with these destructive appliances. The result of the work done through this principle has been highly satisfactory in every city where it has been used.*

Mechanical Trench Filling

By G. M. Gest, Engineer and Contractor, New York City.

The backfilling of trenches is a troublesome problem on work in paved streets, owing to the difficulty of getting the fill so thoroly tamped that there will be no settlement of the paving when relaid over the trench. This problem is encountered by contractors and municipal authorities as well as by engineers, but with the class of labor commonly employed, it is not easy to get the work done well or in the way specified.

Municipalities should require that all back-fills be mechanically tamped, but the following requirements are usually noted in specifications:

1. The trenches are to be refilled by contractor. No specifications stating manner of doing the work. The only clause possibly covering this is the later section of "General Stipulations," where the streets are to be put in as good condition as contractor finds them when commencing work. This clause is generally inserted even when the manner of refilling is specified.

2. To be refilled by shovel and tampers to be used in the trenches. The requirements vary from two tampers to each shoveler or two shovelers to each tamper. Sometimes there may be an equal number of each.

3. Refill the trench to a depth of 1 to 3 feet above the pipe, fill the trench to the top with water and put in the remainder of the material. This is the only proper method for sand and gravel, but an improper method for clay or any earth containing much clay.

4. The trenches shall be refilled and then flushed by the city employes, or by the contractor, in order to settle the trenches.

In specifications like the first and second, it is sometimes required that the filling be put in dry or nothing is said about its condition. Sometimes it is required that the earth be moistened as it is deposited and occasionally it is required to be moistened on the bank before it is shoveled in and tamped. When the prescription of method is followed by the rider that the streets be restored to their former conditions, the contractor is put to a disadvantage, because the method specified may be one that is not suited to the material and it is impossible to restore the streets. When this is coupled with a provision that the contractor shall maintain the street for 12 months from the date of acceptance, the injustice is extended beyond the contractor to the property owners who pay for the work.

The first method, simply requiring the trenches to be refilled and that the contractor put the streets in as good condition as before he touched them, should serve all purposes, provided it was required that the back-fill was to be mechanically tamped.

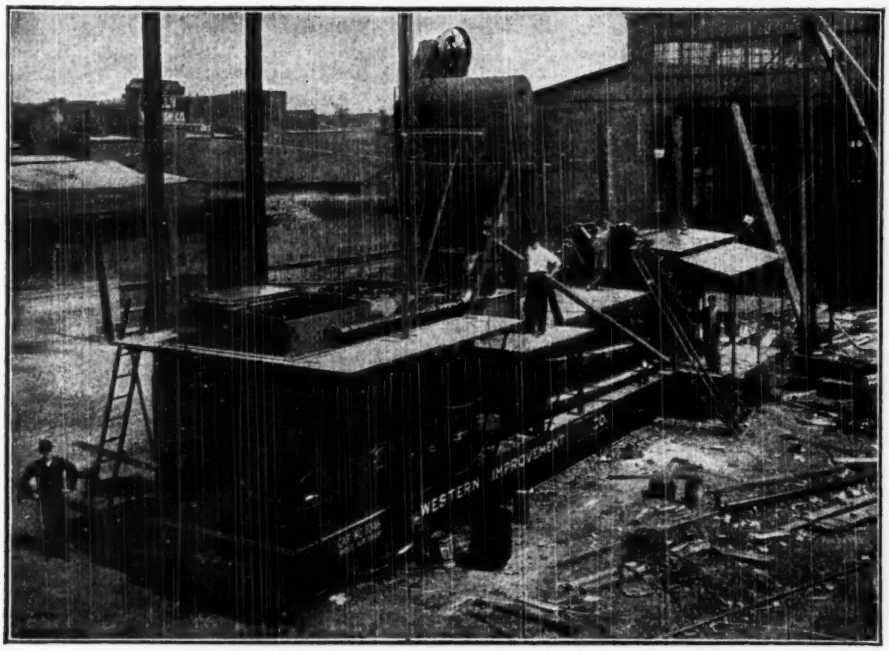
The method of back-filling by any old method and then flushing to settle the trenches is often slighted. Left to a lot of ignorant, unthinking laborers the method adopted is to push a hose clear down until it touches the pipe, turn the water on and go off to the nearest shady spot and sit down for awhile. Of course, the trench goes down, but future house connection work reveals queer looking lines of pipes with joints washed out and damaged stoppers in "Y's." Mechanical tamping, in our opinion, would solve all trench settling problems.

We make a specialty of conduit work and operate six tamping machines, as our experience has conclusively proven that mechanical tamping is far superior to any other method. We are operating these machines at a minimum saving of 50 per cent. over old hand tamping and flushing methods. These six Staley machines, which were furnished us by the Lourie Mfg. Co., Springfield, Ill., consist of two principal parts, the sweep on which is mounted the lifting mechanism, the engine and the two-wheeled truck on which the sweep is mounted. The sweep is built of two 3-inch steel channels, with the necessary spacers, bracing and truss rod, mounted near its center of gravity, on a saddle casting which has a bearing on a pivot on the truck axle. The sweep swings in a horizontal direction on this pivot, thus moving the tamper across the work, while the movement along the work is had by moving the track forward about 8 inches for each complete swing of the sweep. The truck has 4 by 36-inch steel wheels and a 1½-inch arched steel axle. The truck frame is formed of one piece of 2 by 2 by ¼-inch angle. The steel axle spindle is cast into a square socket thru which passes the vertical leg of the axle; the axle at this point is pivoted with about 8 inches of vertical adjustment, and a like amount of adjustment is provided in the cast-iron shoe on the bottom of the truck on the curb or other unlevel surface, and is a valuable feature when the machine is required to work close up to the curb.

New Kelly Power Dump

The Kelly Springfield Motor Truck Company, of Springfield, O., has recently placed on the market a new power dump body. The workings of this equipment are claimed to be distinct and different fro mthose of any other power dump body on the market today.

MODEL OF 1912 ONE-CAR PLANT.



1,000 SQUARE YARDS 2-INCH TOPPING PER DAY.

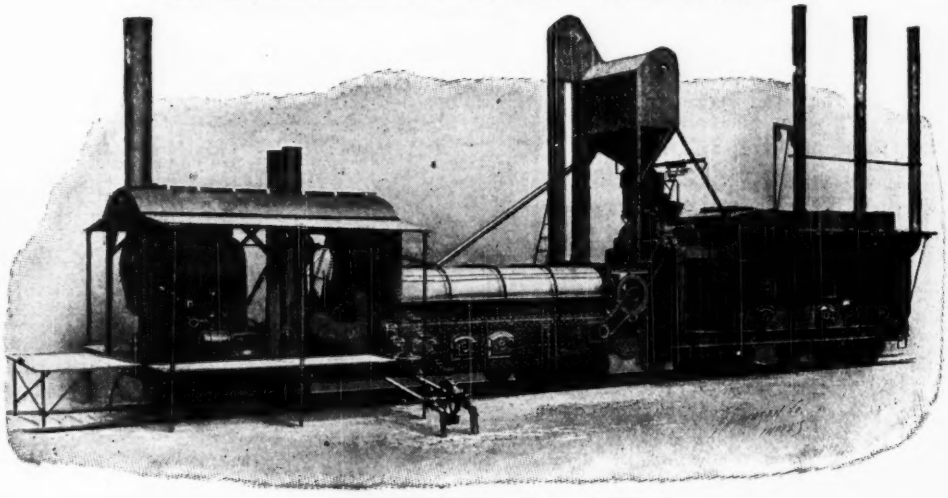
HETHERINGTON RAILWAY ASPHALT PAVING PLANTS

The product of 16 years experience in Plant Building by the originators of the first railway plant. **Still lead, are only safe railway plants made.**

THESE PLANTS HAVE NO EQUALS. WRITE FOR CIRCULARS.

HETHERINGTON & BERNER, - INDIANAPOLIS. IND.

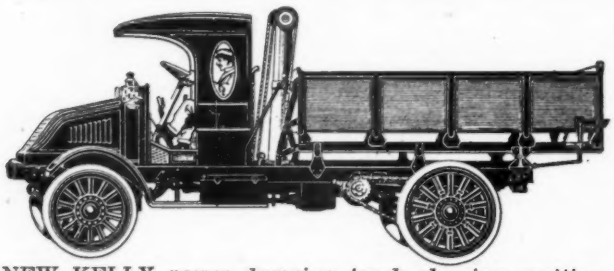
1,500 SQUARE YARDS AND 2,000 SQUARE YARDS PER DAY.



MODEL OF 1912 TWO-CAR PLANT.

The Kelly dumping apparatus is of the hydraulic type and operated with oil. The hoisting device is manufactured by the Wood Hydraulic Hoist Co., of St. Paul, Minn., but the attachments to the body and power transmitting and operating devices are the products of the Kelly engineers.

The device has for its chief component a large size steel cylinder, 6 inches in diameter, inside of which works a conventional type piston with two piston rings on it. The piston is attached to a 2-inch diameter steel piston rod, which extends thru the upper cover flange of the cylinder. To the upper end of this piston rod are attached two steel pulleys to guide the two wire ropes. The back end of each of these wire ropes is fastened to the lifting nose of the steel body; the other end is solidly fastened to a strong equalizer, which insures equal tension on both ropes. This insures that the lifted load is always carried on both ropes.



NEW KELLY *power dumping truck showing position of dumping mechanism prior to lifting of the body.*

A gear pump is fastened to the cylinder base and is driven by means of proper size chains and sprockets from an extension of the transmission countershaft. The pump is driven three times the engine speed. This is done so that the operator will not race the motor when lifting load. Three hundred revolutions of the motor will lift the 3-ton load and bring the body back to its seat in about one minute.

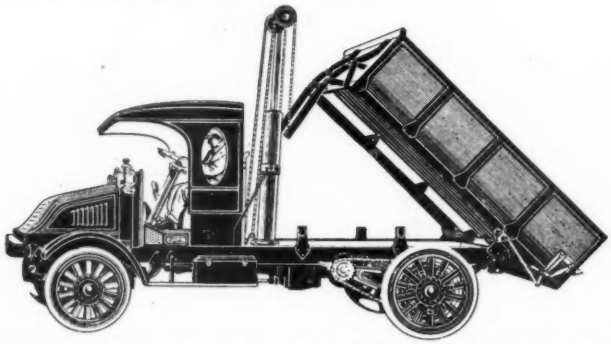
The pump mechanism is controlled directly at the driver's right hand on top of the driver's seat. The operator simply disengages his clutch, just the same as he does to shift speed gears. In doing this, the countershaft of the transmission is brought to a standstill and the lever at the right hand of the driver is pulled in place. The power connection is now accomplished.

The engagement of this extension of the countershaft is locked in a similar manner to the sliding bars of the conventional type sliding-gear transmission. This positive lock enables the driver to leave his seat with the device engaged until he gets thru with dumping.

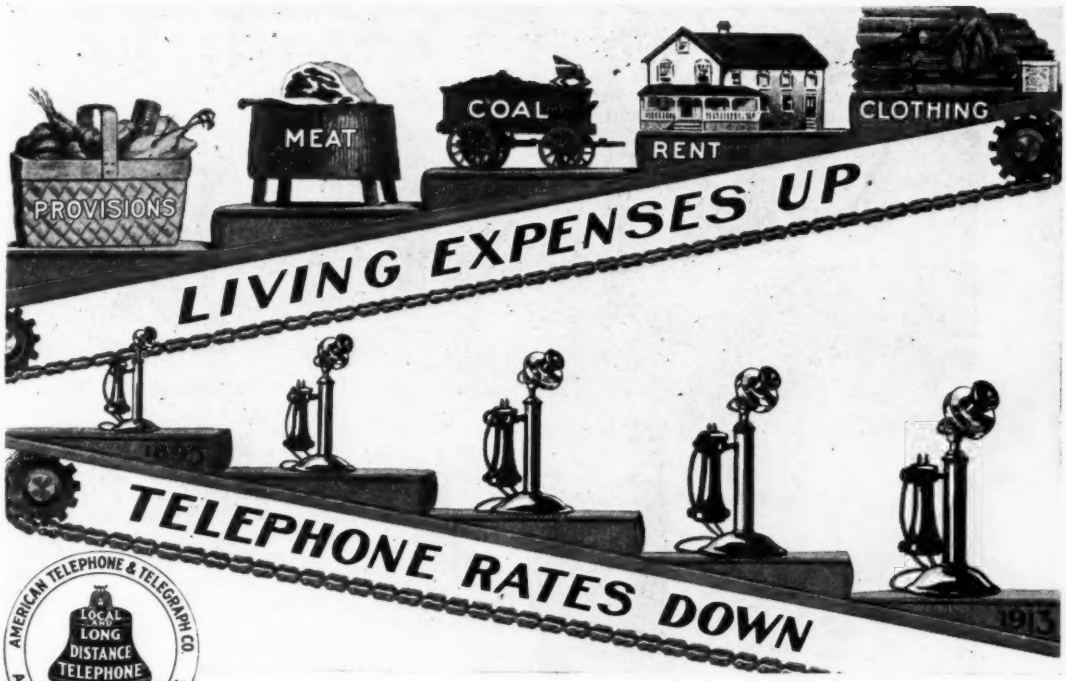
After engaging the power connection the driver may step off, walk back to the machine and open the tail gate, then walk forward to the back seat on the right hand side of the machine. Here is a hand lever which controls the action of the power hoist proper.

By pushing this lever away from himself the hoist will lift. When the lever is in a vertical position the hoist is at a standstill, and by pulling the lever toward himself, the hoist lowers. When the entire body, therefore, is brought back to its seat, the driver may step up to the steering gear, disengage his clutch, pull the power hoist operating lever at his right hand in neutral position, and is ready to move on with his truck.

It is readily conceivable from the above description that the driver of the truck as well as the entire operation of the dumping machinery is but a one-man job. The whole equipment is designed and built with the same characteristic staunchness and simplicity which is so consistently carried out in all Kelly designs.



POSITION *of dumping apparatus when truck body is completely elevated for dumping. Entire mechanism controlled from driver's seat.*



Economy of the Bell System

Consider this significant fact: While most of the necessaries of life have gone up, the price of telephone service, which is one of the essential factors in our commercial and social life, has moved steadily downward.

Although a pound of these necessities still contains but sixteen ounces, the telephone user has been getting more and more service for less money.

On the average, the people of this country pay 49% more today for food, fuel and clothing than they did in 1895. Since then, the decrease in the average rates for telephone service has been more than one-half.

At the same time, the efficiency and value of the service to the subscriber has vastly increased. Today he can talk to an average of five times as many persons in each exchange as he could eighteen years ago.

This is the inevitable result of the comprehensive policy of the Bell System, which brings together the associated Bell companies and the communities they serve.

Through the very size and efficiency of their organization they accomplish improvements and effect economies which give the greatest service at the lowest rates.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

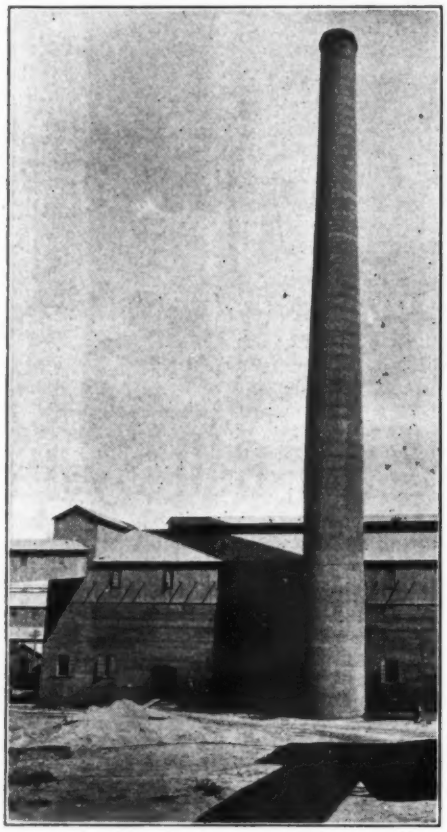
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

Concrete Chimney Construction

Reinforced concrete is becoming a most popular material for the construction of all chimneys for power house, smelter, malleable iron furnaces, blast furnaces and in fact every purpose for which tall chimneys are required.

It is good practice to compute a chimney for 50 pounds per square foot wind pressure; this represents a maximum velocity, and is a conservative basis on



REINFORCED *concrete chimney constructed for Lehigh Portland Cement Co. at Mason City, Ia. Total height 208 feet 9 inches.*

which to figure. The importance of a chimney in connection with any plant, is such a great factor that it is most important that the chimney be in service or ready for service at all times.

The formula of Turneaure & Maurer, of the University of Wisconsin, as published in "Principles of Reinforced Concrete Construction," 1910 edition, is considered the highest authority on the subject of designing and calculating the stresses in reinforced concrete chimneys.

One of the tallest chimneys in the United States is of reinforced concrete construction and is located in Butte, Montana. It was constructed in 1905 for the Colusa Parrott Mining and Smelting Company and was built by the Weber Chimney Company, of Chicago. Another large chimney of the coniform type, built by the Weber Chimney Company, was constructed recently at Mason City, Iowa, for the Lehigh Portland Cement Company. This chimney, which is illustrated herewith, is 208 feet 9 inches high from the base of the foundation, foundation being 6 feet 9 inches below grade. The width of the square part of the foundation is 25 feet 6 inches, greatest thickness of foundation being 5 feet 9 inches, inside diameter at the top of chimney 10 feet 6 inches, tapering to largest outside diameter at base of chimney of 16 feet 2½ inches. This chimney is lined with a reinforced concrete lining to a height of 66 feet 6 inches. The wall at the top is 5 inches thick increasing to 19⅞ inches at the base of shaft. This chimney is guaranteed to be capable of withstanding wind pressure of 50 pounds per square foot and the influence of the atmosphere and chimney gases.

Trade Notes

Nels Erickson, 405 Boston Block, Minneapolis, Minn., will handle the Chain-Belt concrete mixer and other concrete machinery in the city of Minneapolis and vicinity.

The Southern Clay Manufacturing Co., of Chattanooga, Tenn., W. M. Lasley, president, has been licensed by the Dunn Wire-Cut-Lug Brick Co., to manufacture wire-cut-lug brick in their three plants at Robbins, Tenn., Coaldale, Ala., and Chilhowie, Va.

The sixth annual directory of trade and technical publications, 20 cents, is ready for distribution by *Advertising and Selling*, 95 Madison Ave., New York City.

The McCormick Waterproof Portland Cement Co., Chicago, Ill., selling shamrock brand waterproofing compound, has been reorganized with James A. Smith as president and general manager, former president Charles McCormick being no longer connected with the company in any official or authoritative capacity.

H. W. Johns-Manville Co., have opened a new office and warehouse in Galveston, Tex., the third in that state, where heavy shipments will be received by steamer, particularly to the Texas territory and to Central and South American points.

The Mullen apparatus for drying and heating gravel and stone on the street for use in bituminous pavements or for heating stone for concrete, which has been in successful use for several years and is well and favorably known has been

Huber Gas Tractors

Huber Gas Tractors Grading and Hauling for Streets of Speedway City, Ind. (Much of the time running 24 hours per day.) C. C. King Brother & Son, Contractors.

Are Building the Streets of the New "Million Dollar City"

Three Huber "Thirty-Sixty" Gas Tractors

—are **carving a complete town out of an open piece of farm land** near Indianapolis at **exceedingly** low cost.

—are hauling in **faster** time, **twice** as many **heavier** loaded carts per unit of power than horses at gasoline **cost less** than expense of feed for horses to do same work.

—are **saving the expense of at least ten men per outfit** compared with horses and wagons.

"Grading for a $1,000,000.00 City"

is the title of a folder

SENT FREE ON REQUEST

The utility of this "Thirty-Sixty" tractor for contract work is unquestioned. It has speed and power, both essential to handling a big contract profitably. The traction wheels are eight feet high. This gives it an unusually strong grip on the ground, makes it a strong puller, and enables it to travel over soft surfaces that would be difficult to cover otherwise. Either gasoline or kerosene may be used as fuel with equally good success.

HUBER COMBINATION ROAD BUILDERS ARE BIG MONEY SAVERS

The Huber Manufacturing Co.

601 Center Street. **MARION, OHIO.**

Representatives for Eastern Canada, F. H. HOPKINS & CO., Montreal.

patented, the application for patent having been filed in 1910 and the patent issued Sept. 30, 1913. C. A. Mullen, superintendent of public works, Schenectady, N. Y., is the patentee.

E. U. Heslop is in charge of the new branch office of the H. W. Johns-Manville Co., at Charlotte, N. C.

The Raymond Concrete Pile Co., 140 Cedar street, New York, has received contracts for their concrete pile foundations from the Maryland Steel Company, Sparrows Point, Md., for a new gas engine building; for the grain elevator addition to the new brew house for the Los Angeles Brewing Co., Los Angeles, Cal.; for the new Standart Brothers building, Front street, Detroit, Mich; from the American Dock Company, 21 State street, New York City, for a new seven-story warehouse at Tompkinsville, Staten Island; from J. I. Case Threshing Machine Company, Racine, Wis., for their new branch warehouse at Kansas City, Mo.; for the new Riverside plant of the Otis Steel Co., Cleveland, O.; for the new church at Twenty-eighth place and Wallace street, Chicago; and for the new building for the Standard Oil Company at Buchanan, N. Y.

Trade Publications

Class M, Chicago pneumatic, Corliss type, steam-driven compressors are the subject of Bulletin 34-T of the Chicago Pneumatic Tool Co.

The latest catalog of the Western Wheeled Scraper Co., Aurora, Ill., shows the latest improvement in earth and stone handling machinery.

Integral Waterproofing Co., 50 Church St., New York, will send circulars showing the extent of the use of Keystone waterproofing compound for concrete in fresh and salt water and reproductions of letters from satisfied users.

The Independence Brick Co., Independence, Kan., is sending out an A B C card, the A standing for the asphalt filler furnished by the Standard Asphalt and Rubber Co., the B for the paving brick made by the Independence Brick Co., the C for portland cement made by local mills, and the whole card for the brick pavements of Independence "the cleanest town in Kansas."

The Universal Portland Cement Co. has issued a number of pamphlets on the use of cement during the past summer, among which are "Specifications for Construction of One-Course Concrete Street Pavement," "Specifications for Construction of One-Course Concrete Highway," "Specifications for Two-Course Concrete Street Pavement," "Concrete in the Barnyard," "Small Concrete Bridges and Culverts," "Concrete Highway Bridges," "Concrete Silos," "Concreting in Cold Weather," "Concrete Surfaces," "Cement Drain Tile," "Small Farm Buildings of Concrete," "Concrete Pavements, Sidewalks, Curb and Gutter."

The Barber Asphalt Paving Co., Philadelphia, Pa., is demonstrating the applicability of Trinidad Lake asphalt to use in roofing cements and will send on request circulars concerning the product and specifications for standard 4-ply Trinidad Lake asphalt roof to be applied over boards, and to be applied over concrete or hollow tile.

"The Kennicott Company," by Elbert Hubbard, tells the story in entertaining form of the company and its water softeners.

Continental automobile fire apparatus is described in an illustrated booklet of the Ahrens-Fox Fire Engine Co., Cincinnati, O.,

"Harvest Time," is the title of a booklet of the Koehring Machine Co., Milwaukee, Wis., describing their concrete mixers as used by paving contractors.

Catalog 60 of the Van Dorn Iron Works Co., Cleveland, O., shows their joist hangers, port caps and bases for all kinds of uses.

E. G. Soltmann, New York, send samples of reproductions by their new inkograf process.

"The Wonderland of Trinidad," is the title of an elaborately illustrated bookleet issued for free distribution by The Barber Asphalt Paving Company, Philadelphia. The text and pictures are confined to description of the island of Trinidad, its asphalt lake and the mining and handling of asphalt up to the refining stage. This is the first publication in any form that gives an adequate idea of the natural wonders of an asphalt lake, its formation and the physical conditions surrounding such deposits.

The eleventh edition of the Hy-Rib Handbook has just been issued and contains many additions, including the new seven-rib hy-rib and the applications of hy-rib to such structures as the dome of the Cuban president's palace, at Havana, a large concrete railroad culvert, the passageway at the Wayne county home and the like, with full specifications for all uses, details of connections, etc.

Catalog 10 of Raymond Brothers Impact Pulverizer Co., Chicago, Ill., is devoted to their grinding, pulverizing and separating machinery.

The largest railroad terminal in the world and how it is waterproofed are shown in a recent publication of the Barrett Mfg. Co.

Some test data on fireproof floor construction, relating to cinder, concrete, terra cotta and gypsum, are given in a recent publication of the Clinton Wire Cloth Co., Clinton, Mass.